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GOLD MINES
AND
MINING IN CALIFORNIA.

A NEW GOLD ERA DAWNING ON THE STATE.

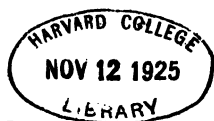
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PERFECTED METHODS, PROCESSES AND MACHINERY

**VAST EXTENT OF AURIFEROUS TERRITORY; RICH AND VARIED CHARACTER OF
DEPOSITS; A COUNTRY ABOUNDING WITH THE ELEMENTS OF SUCCESS;
GRAND FIELD FOR THE PROFITABLE INVESTMENT OF
THE WORLD'S SURPLUS CAPITAL**

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PREFACE.

California has produced to date nearly a billion and a quarter dollars worth of gold; more, probably, than has ever been produced by any other country. Her gold fields have a linear extent of 600 miles, and cover an area of 8,000,000 acres. Within this territory the auriferous deposits are numerous, extensive and diversified, comprising every form and kind met with elsewhere in the world, and even some that may be considered peculiar to this country. Along our main mineral range occur thousands of gold bearing quartz lodes, immense banks of hydraulic gravel, hundreds of miles of ancient and modern river beds, still nearly virgin, with a vast area of bar, gulch and dry diggings, only partially exhausted. Here, in the cañons and other outletting channels, are lodged millions of tons of tailings that will pay for rewashing, while at intervals along the sea-coast occur, for hundreds of miles, gold bluffs and beaches, the former remaining almost untouched, and the latter, with the proper appliances, still capable of giving profitable employment to many workmen.

Because the bullion product of California has fallen to a comparatively low figure, it is generally supposed that her mineral resources have been depleted to a corresponding extent, and that they are now about exhausted. But this is true only of her superficial placers, such as the modern river bars, the gulches, shallow flats, and certain portions of the beach sands, river beds and drift diggings, all of which being easily reached and opened, were first attacked, and being worked by such crowds of energetic men, are now pretty well exhausted. That they proved so remunerative while they lasted, was due to the fact that the gold had, so

to speak, been already mined by natural agencies, and brought within the easy reach of those who came to gather it. It is a stretch of courtesy to call this set of men who, coming here first, looted our gold fields and left, miners at all, the term digger, sometimes applied to them, being much more appropriate. These pioneers having so skinned the surface of its rich and easily obtained treasures, it requires now very different means and methods to utilize the more deep-lying, but vastly more extensive and lasting deposits, that still remain to be opened up. For successful gold mining in California on anything like a large scale, skill, capital and good business management are now indispensable. Costly, complicated and ponderous machinery for extracting and reducing the ores, has now to be provided. Without these, not much, save in exceptional cases can be done. With these supplied, however, the auriferous deposits of this State open the best field for the investment of capital on the face of the globe.

As remarked in the prospectus issued by the publishers of this book, we have at length so perfected the business of gold mining in California, both as regards the methods, machinery and processes in use, that material of very low grade, whether quartz or gravel, can be handled with profit. Latterly very few failures have occurred in this business; fewer, perhaps, than in any other of our leading industries, nor are many likely to occur hereafter. As now conducted, it is, in fact, fully as safe as farming, manufacturing, or merchandising, paying, at the same time far better than any of these.

It is the opinion of those most competent to judge, that California could, with a little well directed effort, and the aid of a moderate amount of capital, be restored, in the course of a few years, almost to her former supremacy as a gold producing country; that is, instead of producing, as at present, not more than fourteen or fifteen million dollars per annum, she could easily be made to produce thirty-five

or forty millions, and that three times as many men as are now engaged in our gold fields, could then find profitable employment there.

What such a production would do for our other interests and industries, now depressed and languishing, it is easy to foresee. With it would come a multiplication of manufactures, an extension of trade, increased demands for the products of agriculture, higher prices for labor, and better times for all. It would regenerate California, and restore to her something of her ancient greatness—something of the glories of pioneer times; a consummation for which every true Californian, it may reasonably be expected, will labor and hope.

We offer no apology for inserting in these pages, notices of such machinery, methods and appliances as seem best adapted for economical and efficient ore reduction; the objects of this book being to describe, first, the mines and mining localities, and second, the best means, so far as ascertained, for treating the ores. While making no invidious comparisons between different mechanisms and processes, we have not hesitated to recommend such as have established by practical tests their excellence, if not, also, their superiority.

This being a book of a thoroughly practical kind we have not scrupled to appropriate such matter as seemed best adapted to our purpose, wherever the same could be found. Hence we have, as will be seen, drawn freely on the columns of the *Mining and Scientific Press*, and on the several reports of the State Mineralogist of California; some drafts having also been made on the newspaper press of both the city and State at large. As in making such new use of this matter a good deal of it has required more or less alteration at our hands, we have dispensed with quotation marks, believing that this statement will be deemed a sufficient acknowledgment of our obligations on this score.

GOLD MINES

—AND—

MINING IN CALIFORNIA.

GEOGRAPHICAL POSITION, AREA AND PHYSICAL FEATURES OF THE STATE.

Before proceeding to consider the main subject of this book, it may be proper to say a few words about the climate, topography, scenery and general aspect of California, which is situated between latitude $32^{\circ} 45'$ and latitude 42° north, and between the 38th and the 47th meridians west from Washington, being bounded on the north by Oregon, on the east by Nevada and Arizona, on the south by the Mexican Department of Lower California, and on the west by the Pacific Ocean, on which it has a coast line 1,097 miles in length. Measured along its greatest longitudinal axis, which bears nearly northwest and southeast, the State is a little over 700 miles long, and has an average width of nearly 200 miles.

According to the last annual report of the State Mineralogist, from which we will have occasion to quote frequently in the following pages, the area of the State approximates 156,000 square miles—in round numbers 100,000,000 acres of land. Of this land, about 36,000,000 acres may be said to be, in its natural state, well adapted to agricultural pursuits of almost every kind, nearly all of it being equally well suited for stock raising; 30,000,000 acres, producing a variety of nutritious native grasses, constitute good grazing, and for the most part, also, good fruit-growing lands, though

little fitted for farming purposes; 20,000,000 acres are mountainous and of not much value for farming or grazing, though nearly the whole of it is heavily timbered; 5,000,000 acres are composed of tule fens and overflowed lands, capable of easy reclamation, and which, possessing a deep, rich soil, must ultimately become exceedingly productive; the balance—5,000,000 acres—consists of alkali flats, lava beds, and sage plains, too saline, arid, and barren to ever be worth much for agriculture, though some portions of them may answer for sheep and cattle ranges.

TOPOGRAPHY—SYSTEM OF MOUNTAINS.

The principal mountains of California consist of the Sierra Nevada, the Inyo, and the Coast Range; the latter, which is made up of a series of parallel ridges and outlying spurs, extending along the western border of the State throughout nearly its entire length. The Sierra Nevada, on the other hand, stretches along the eastern border of the State for at least two-thirds of its length, the Inyo Mountains lying beyond and running parallel with a part of the Sierra. In both the northern and southern portions of California occur various cross ranges and groups of mountains, together with numerous isolated peaks, buttes, and clusters of rugged hills; some of which are connected with, while others are wholly separated from, the dominating mountain chains. To the most of these lateral spurs, ridges, and outstanding groups distinct names have been given. Some portions of the Sierra Nevada are very lofty, Mount Whitney, the most elevated peak in the chain, being over 15,000 feet high, and, with two or three exceptions, the highest land in North America. There are several other peaks here that reach an altitude of 14,000 feet, there being many in the Sierra, with some also in the Inyo range, that vary from 10,000 to 12,000 feet in height. A number of peaks and ridges in the Coast Range approximate a height of 8,000 feet. The lower slopes of the main mountain ranges

having been eroded by the swift decending streams into long ridges, undulating prairies, and lawn-like dells, are known as the foothill regions of the State.

THE VALLEYS OF CALIFORNIA

Are numerous and occur under widely varied conditions. Some are small and cradled far up in the mountains ; some are larger and inclosed by hills of gentle acclivity, while others are of great extent, expanding into vast plains, little elevated above tide water, the immense depression lying between the Coast Range and the Sierra Nevada, four hundred miles long and fifty miles wide, the southern half known as the San Joaquin and the northern as the Sacramento Valley, furnishing the best example of these valley-like plains to be found in the State. The valleys of California are all fertile, and while the smaller ones are for the most part tolerably well watered and timbered, the larger are apt to be deficient in this respect. But as tree culture is beginning to be practiced everywhere, and water can be supplied to most of these valleys by artesian boring, or can be brought in from the neighboring mountains, the above defects will in course of time be measurably remedied.

HYDROGRAPHY.

About one and a half million acres of California territory are covered with lakes, bays and navigable rivers, the Bay of San Francisco constituting the largest body of water in the State. Besides this California contains only two other wholly land-locked bays—Humboldt and San Diego. Tahoe, one-third of which lies in Nevada, is the largest and deepest lake in California, being 21 miles long, 12 wide, and 1,600 feet deep. It lies at an altitude of 6,000 feet, is fed by numerous streams from the adjacent mountains, and through the Truckee River discharges an immense quantity of water. The other considerable lakes in the State are Tulare, Mono, Clear, Klamath, Goose, Wright, Modoc, and Owens. Be-

sides these there are many small deep lakes in the Sierra Nevada, and to the east of that range others so extremely shallow that some of them dry up in the summer, for which reason they are usually called "mud lakes." Mono, Owens, and some other of these Californian lakes, are so saturated with the carbonate and sulphate of soda, the chloride of sodium, borax, etc., that bathers float readily on the surface of their waters. Some, like Tulare and Honey Lake, cover a large area in the spring and early summer, when the snow melts on the mountains, but shrink to comparatively small dimensions later in the season.

The principal rivers of California are the Klamath and Trinity in the northern part of the State, and the Sacramento and the San Joaquin, formed by a great number of tributaries having their sources in the Sierra Nevada, some of which are themselves streams of large size. These two rivers, flowing the one south and the other north, meet in the middle of the great basin to which they give drainage, and making a deflection to the west, debouch through the Golden Gate into the Pacific Ocean. The southern third of California contains no lakes or large rivers, or even streams that in most countries would be called rivers at all, none of them being navigable, while many nearly or wholly dry up during the summer season.

THE FORESTS AND PARTIALLY WOODED LANDS.

While some parts of California are well timbered others are but sparsely wooded or entirely treeless. The Sierra Nevada to a height of eight thousand feet, as also its higher foothills and some portions of the Coast Range are clothed with magnificent forests of pine, fir, spruce, and cedar; much oak up to four or five thousand feet growing in these forests. The higher foothills of the Sierra Nevada constitute the habitat of the so called "Big Trees," *Sequoia gigantea*, some of which measure at the base over one hundred feet in circumference, and three hundred and fifty feet in

height. Being a species of cedar, these trees make a superior article of lumber.

Along the northern coast occurs a belt one hundred miles long, and from ten to fifteen wide, covered with a heavy growth of redwood. These trees, also a species of cedar, reach gigantic dimensions, some of them yielding from 50,000 to 60,000 feet of lumber. The foothills, up to a height of about two thousand feet, are covered with a scattered growth of oak and scrubby pine that burn well when dry, but are worth little for lumber. These oaks generally extend in the form of scattered groves down into the valleys, being about the only trees found there. The most of the larger valleys are in fact but sparsely wooded, what few trees they contain growing along the margins of the water-courses. These valley oaks often attain large proportions, single trees when cut up making as much as twenty or thirty cords of firewood. They do not, however, grow to a great height, but have a short, thick trunk which throws out many large branches, one of these trees sometimes shading half an acre of land. On the sage plains and deserts in the southeastern part of the State grow a few yuca palms and some mesquit trees, the latter a solid heavy wood, and excellent fuel, but the former useless alike for fuel or lumber. The alkali flats, lava beds, and tule lands are without timber. Taken as a whole, California may be considered a well wooded country, her coniferous forests covering some twenty millions acres, constituting, beyond any question, the most valuable timber lands in the world. With these mighty preserves, which when cut away, rapidly reproduce themselves, and the much tree culture now going on, nothing but the most criminal waste can ever produce anything like a timber dearth in this State.

SCENERY.

What with her long and lofty ranges of mountains, majestic forests, and park-like hills; her picturesque valleys,

deep gorges, and wide, extended plains, the scenery of California may be pronounced unique, grand, and beautiful in the extreme. The towering peaks of the Sierra, and the softly rounded domes of the Coast Range arrest the attention, conspicuous from afar, while from many an eminence the great trunk rivers can be seen meandering for hundreds of miles through wheat fields and tule savannas, fed by innumerable streams that tumble in cataracts down the woody slopes of the mountains. Everything here has been projected on a scale well befitting this "Garden of the Gods." The waters of the Pacific lave the State on one side, while the snow-clad heights of the Eastern Cordillera look down upon it from the other. The gates of the Yosemite open into chasms as deep and precipitous as any found elsewhere in the world. Up from the champaign spring pinnacled buttes and crested ranges with chimney-formed rocks, tall and impending, while here and there a volcanic cone stands dark and lonely like a sphinx on the desert, for even these fields of desolation, over which "the mirage dances and the sand-storm sweeps," possess something to charm the lover of solitude as well as to interest the student of nature. How hardly can we find in other countries anything more satisfying to the artist, the tourist, or the scientist, than is to be seen here within the limits of California. The Alps and the Andes enjoy a well deserved fame for the grandeur of their scenery, while the views along the Rhine and the Hudson amount to an enchantment. But California, if she fail to combine all that is best in these, possesses in her scenery so much that is diversified, original, and vast, that it cannot fail to fill the appreciative mind with both admiration and wonder.

CLIMATE.

The most notable thing about the climate of California is its division into a wet season and a dry, the former extending from about the middle of November till the end of April, though it often begins a little earlier and continues for

several weeks later. During this season there are generally from twenty-five to forty entirely rainy days, which occur at intervals of two or three, hardly ever of more than four or five, in succession. December and January are apt to be the wettest months, the rain for the rest of the time falling in showers, with occasionally an entirely wet day. Very little rain falls during the dry season, sometimes not even a shower from one end of it to the other. The injury caused by such protracted drought is not so great as would at first be supposed, for, while the grass withers and the streams dry up, and the dust accumulates to a fearful extent, these evils are offset by many advantages. The roads, though dusty, are free from mud; outdoor work goes on without interruption; the farmer may cut his grain at his leisure, as it takes little harm from standing a week or two after being ripe. Neither the hay nor the grain, after being cut, is apt to be injured by rain. Having been stacked, or gathered into heaps, the grain can be left to be thrashed, and the hay to be pressed and housed at any time before the wet weather comes on. So, also, the viticulturist may leave his grapes on the vines, and the orchardist his fruits on the trees, long after they are ripe, gathering them when it best suits their convenience. While the grass so dries up, and fails to renew itself before the next rainy season, it does not lose its nutritious properties, cattle thriving upon it almost as well as when it is green. Rain occurring during the dry season causes only harm, as it bleaches the substance from the grass after it has been converted into hay, and no one being prepared for it, works much injury besides.

Except on the mountains and higher foothills, but little snow falls, nor does much ice ever form in any part of California. The climate along the coast, and for 20 or 30 miles inland, is mild and equable, no extremes of heat or cold being ever felt here. Further inland, the Summers are hot, and the Winters somewhat colder than along this coast belt. Yet, in all the valleys of California, except the more elevated,

apples remain on the trees, and vegetables in the ground, without freezing, while flowers bloom the whole Winter long. Stock, with the exception of milch cows and work cattle, receive little or no fodder, nor are any but work horses housed during the Winter. There are many localities in the southern part of the State that have over three hundred entirely clear days in the course of the year.

As the climate of California is so genial and temperate, so is it little liable to destructive tempests, violent electrical disturbances, or dangerous meteorological phenomena of any kind. From the cyclones and blizzards that have of late proved so disastrous to life and property in the Eastern States, California is wholly exempt, while the number of deaths from sunstroke and lightning does not exceed a dozen, all told. By the earthquakes, concerning which so much has been said to her disparagement, not over a score of lives have been lost since the American occupation of the country—scarcely more than one on an average every two years. The people of this State know nothing of famines, and little of floods, destructive inundations and damaging droughts being of rare occurrence here. Another good point about the climate of California is its extreme healthfulness. In few other countries is the death rate so small. Endemic diseases can hardly be said to exist here, while those of an epidemic kind generally prove to be of a mild type, being not often attended with fatal results.

POPULATION, WAGES, COST OF LIVING, ETC.

California contains now about one million inhabitants, of whom nearly one hundred thousand are Chinamen. Of these people, about thirty thousand reside in San Francisco, where the most of them are employed as domestics, or engaged in washing and manufacturing cigars, clothing, boots, shoes, slippers, etc. Half as many, perhaps, live in the interior cities and towns of the State, where they are in like manner employed. Fifteen thousand work in the

placer mines, chiefly on their own account. Several thousand carry on gardening, mostly in the vicinity of the larger towns. A few are fishermen, while a great many are employed in the canneries, at railroad building, in the reclamation of the tule lands, and in picking fruit, grapes, berries, etc., there being but few industries in the State but what employ some of these people.

While the prices of labor in California have been steadily declining ever since the memorable year '49, the presence of the Chinese in the State has tended to precipitate the wages of the working classes in advance of all other prices, the rates paid for most kinds of labor being now not much higher in this than in the Eastern States. The difference in favor of California, except in the case of some skilled branches, will not average more than twenty per cent. Ordinary farm hands, for example, receive not over \$20 per month and found, the year through. Wages during the harvest season range from \$35 to \$40 per month, or \$2 per day and found. In the cities, common laborers receive from \$1.75 to \$2 per day, finding themselves. In the machine shops, foundries, and similar works, daily wages vary from \$2.25 to \$3, these being about the rates paid in all manufacturing establishments, and about what mechanics, miners, engineers, teamsters, etc., are able to earn in California. Good axmen and sawyers are in demand in the lumber regions at extra high wages. In the canneries, cigar factories, and other establishments, where women, girls and boys can be employed to advantage, the average earnings are not over \$1 per day—the usual length of a day's work in California being ten hours.

Taken as a whole, the staple articles of subsistence are not much dearer here than in the Atlantic States. Rents, fuel, water and lights, milk, eggs, butter and cheese, with some other items of prime necessity, are from twenty to fifty per cent. higher here than there; flour, fish, fresh meats, fruits and vegetables, furniture, common clothing, boots

and shoes, about the same. Considering how little fuel and extra warm clothing are required in California, and how comparatively few days need be lost by reason of sickness or bad weather, the laboring man can afford to live better here, and be able at the same time to lay up more money in the course of the year, than he could do in any other country.

EARLY LEGENDS, AND FIRST IMPORTANT DISCOVERY OF GOLD.

It is a mistake to suppose, as is generally done, that gold was first found in California at Sutter's Mill, in the month of January, 1848. Although the grand discovery of that metal which caused such an excitement the world over, led to the rapid peopling of this country with immigrants from all lands and produced so many other important results occurred then and there, placers had been worked within the present limits of California in a small way long before that date. The impression that this was a gold-bearing country had, in fact, obtained among the nations of Western Europe from, and even before the time of its first discovery, having been founded on the reports of navigators along the North Pacific Coast, magnified, as was their wont, by the chroniclers of these earlier times.

The following account of the extravagant notions entertained on this subject at that day, the explorations carried on along this coast, and the land expeditions sent out on these gold seeking errands, is compiled from a pamphlet prepared by Dr. Henry DeGroot, and published not long since by A. T. Dewey & Co., of San Francisco.

According to this authority, Sir Francis Drake, the renowned English navigator, in the summer of 1579, entered the bay which now bears his name, and anchoring his vessel remained there several weeks. Before departing, he took possession of the country in the name of his sovereign, Queen Elizabeth, and called it New Albion. On his return

to England, with a view, probably, to giving importance to his new possessions, Drake represented the country as abounding in gold, so much so that Hakluyt, the historian, in speaking of it declares that "there is no part of the earth here to be taken up wherein there is not a reasonable quantity of gold or silver." Inasmuch as there is no gold or silver anywhere about Drake's Bay, which lies nearly in latitude 38°, and thirty miles north of the Golden Gate, the above statement is clearly a fabrication of the great navigator. Had Sir Francis went ashore a hundred or two hundred miles further north, where the gold bluffs and beaches occur, there might have been some ground for the representation so made. But as the bay called after him is as far as he voyaged in that direction, the existence of these auriferous deposits avails not to save his veracity from successful impeachment.

But this notion about gold in California did not originate with Drake and his contemporary historian. In the same year that he visited this coast, a book was published at Lorraine, in which occurs the following passage: "The soldiers of Vasquirus Coronatus having found no gold in Vivola, in order not to return to Mexico without gold, resolved to come to Quivera (California), for they had heard much of its gold mines, and that Tatarraxus, the powerful King of that country, was amply provided with riches."

After the conquest of Mexico, the Spaniards, incited by the vague stories told them by the natives of the country, were ever engaging in expeditions off this way in search of the precious metals. And when these adventurers arrived in Arizona, here, again, the inhabitants gave them to understand that the gold-producing lands they were so eager to find lay still further to the northwest. In so advising their unwelcome visitors, these people might themselves have believed what they said to be true, though possibly this was a ruse to induce these marauders to move on, and thus rid the country of their presence. Between the years 1610 and

1660, more than twenty expeditions were sent out from Mexico to explore and occupy the regions to the northwest, under the impression that they abounded not only with gold and silver, but also with pearls, diamonds, and other precious stones.

How signally these efforts failed of their object is denoted by the fact that prior to 1848 only a few placers, poor and of comparatively limited extent, were ever found in California; so unimportant, in fact, were these gold finds, that not much was ever heard of them outside the country, and very little in it. The first of these placers, which was discovered by the Mexicans as early as 1775, is situated near the Colorado River, in the extreme southeastern angle of the State. Fifty-three years later, deposits of free gold were found at San Isidro, further west, in San Diego County. In 1833, some little gold was gathered in the valley of the Santa Clara River, in the northwestern part of Los Angeles County. Five years later, the San Francisquito placers, located in the Sierra San Fernando, at a point forty-five miles northwest from the Pueblo Los Angeles, were discovered. These, the most productive deposits yet met with, were afterwards worked in a small way for a period of twenty years or more. The deposits at the other places mentioned, owing to their poverty and a lack of water in the neighborhood, were never much worked. And thus it was, that with all these legends and reports about gold in California, the country, prior to the discovery at Sutter's mill, produced very little of that metal, not more, perhaps, than two hundred thousand dollars worth, all told.

As it has been surmised that the Mexican Government were not well informed as to the existence of gold in California at the time that they parted with the country under the treaty of Guadalupe Hidalgo, it may be pertinent to state here that such was not the fact. The late Gregory Yale, in preparing his well known work on the legal titles to mining claims and water rights in this State, being

obliged to make extensive research among early Spanish archives, discovered there the following document, showing that the Mexican authorities were at that time not only advised as to the existence of placer mines in California, but that the extent and importance of these deposits were greatly exaggerated by the party communicating this information. This document, which consisted of a letter addressed to the President of the Republic by Manuel Castanares, Representative in the National Congress from the Department of California, was published in the City of Mexico, in 1845, though it bears the date of March 2d, 1844, nearly four years before the Marshall-Sutter discovery of gold. This letter, translated for the above work by the expert Spanish scholar, Charles G. Yale, reads as follows :

“The gold placers discovered in the course of last year, have attracted the greatest attention, for they extend nearly thirty leagues. The good quality of this metal is made manifest by the certificate of its assay, which was made at the Mint of this Capital, and by the sample which I send to Your Excellency. In order to develop the great elements of wealth in which California abounds, measures ought to be taken only after mature deliberation. I, therefore, shall have the honor, within a few days, of presenting to Your Excellency a memorandum detailing these elements, and the means of developing them with very little sacrifice.”

A few months later, Representative Castanares addressed to the President of the Republic, the following additional paper on the same subject:

“The mining interest in California is of great importance, and I have the satisfaction of assuring you that it forms one of the most valuable resources of that department. Besides the silver mines, which are found there, and various other mines, which have actually yielded metals, the gold placer, especially, is worthy of great attention, which, extending nearly thirty leagues, was discovered lately, together with

mines of mineral coal. It is painful for me to have to confess that mining is in a worse state than agriculture. The latter is in its infancy; the former, it can be said, is not yet born, notwithstanding that, according to the nearest estimate of reliable persons in Los Angeles, on my departure from that town in December, 1843, there were in circulation about 2,000 ounces of gold, which had been extracted from the above mentioned placer, the greater part of it destined to go to the United States. This metal contains, according to the certificate of its assay by the Mint of this Capital, which I sent to the government at the beginning of this year, twenty-two carats two and a half grains of gold, fifteen grains of silver.

“September 1, 1844.”

The foregoing, though a gross exaggeration of the real facts, establishes how thoroughly the Mexican authorities were posted as to any and all gold discoveries that had, up till that time, been made in California.

Owing to various incidents and events connected with the acquisition of this country by the United States, and the efforts made by our government for establishing steam communication with the Pacific Coast, some have thought that the authorities at Washington had some unpublished advices in regard to the existence of gold here, prior to the consummation of the treaty with Mexico, and to their contracting for steamers to ply on the routes between New York and San Francisco. In support of this theory, the fact is cited that within six weeks after the time that gold was discovered at Sutter's mill, the treaty ceding to us this country was signed by the contracting parties, the Mexican Commissioners being ignorant of this important event, and our government affecting ignorance of it also. Then, the vessels of the Pacific Mail Steamship Company were required to be ready for service by the month of October, 1848—just the time when the news of the gold find, having excited the more adventurous, had inspired thousands with a desire to emi-

grate to the new El Dorado. Pointing to this singular concatenation of events, it is argued that the American government must have been actuated by some special reasons for hurrying treaty negotiations to a close, and for requiring the steamship company to have their first vessel ready to sail at this particular time. In the absence of any stronger evidence than the above, it is fair to presume, however, that officials at the national capital were no better posted in regard to the existence of gold in California, than was the general public, the events cited being mere coincidences, such as might easily happen in transactions of this kind.

That the government was in possession of more full and, perhaps, accurate information in regard to the mineral and other material resources of this country, than the world at large, is likely enough, as it would naturally take measures, while negotiating the purchase of so much territory, to ascertain something in regard to its probable worth. In the month of March, 1846, Thomas O. Larkin, then United States Consul at Monterey, in an official letter to James Buchanan, Secretary of State, writes as follows: "There is no doubt but that gold, silver, quicksilver, copper, lead, sulphur, and coal mines are to be found all over California; and it is equally doubtful whether, under their present owners, they will ever be worked." In this expression of opinion, so temperate compared with the statements contained in the letters of Manuel Castanares, our Consul may be understood to convey the idea that these various metalliferous deposits, until then so neglected, would be actively worked were the country owned by the United States.

In 1841, James D. Dana, minerologist to the Exploring Expedition under Commodore Wilkes, which that year visited this Coast, made an overland trip from Oregon to San Francisco. In a book on Mineralogy, published by him the next year, this author states that gold was to be found in the Sacramento Valley, and that he had observed auriferous rocks in Southern Oregon, but that he did not consider

these deposits of any practical importance. That Consul Larkin, in his letter to the Secretary of State, was speaking in an indefinite way, having but vague ideas as to the extent or value of the deposits he alludes to, is evident from the fact that he makes mention of silver, quicksilver, coal, and sulphur mines, concerning which nothing certain could then have been known. He had probably no more exact knowledge of such mines than was common to the inhabitants of the country at that day. They had observed in certain places indications of the presence of these metals and minerals, and surmised that there might be valuable deposits at these points. With regard to gold, Mr. Larkin could speak with more assurance, as small quantities of that metal had, for a number of years before, been taken out at the San Francisquito placers, and brought to Los Angeles, where it was sold at the rate of about twenty dollars per ounce. As these were the placers to which Señor Castanares must have referred in his communications to the Mexican government, the extravagance of his language in describing them becomes manifest, when we reflect upon their limited extent and the sorry showing they have since made in the gold product of the country.

The foregoing comprises about all the knowledge extant, touching the occurrence of gold in California, prior to January, 1848.

WHY FREMONT FAILED TO DISCOVER GOLD.

Having related all that was known as to the existence of gold in California prior to its discovery, we come now to consider some of the principal actors in, and the circumstances that led to that event. Before entering upon this subject, it may, perhaps, be proper to state that some surprise has been manifested that John C. Fremont failed to discover gold at an earlier date, seeing he was sent out by our government to explore the country, was accompanied by a competent mineralogist and geologist, and arrived here

nearly two years before the find occurred at Sutter's mill. It is argued that, having been dispatched on such special mission, and being aware that some placers had previously been found and worked in the southern part of the State, he ought to have struck gold somewhere along his route, inasmuch as it led down the south fork of the American River, on which the great discovery was afterwards made. But to this it may be replied: General Fremont, with his command, consisting of sixty-two frontiersmen, scientists and guides, entered the country in an exhausted and famished condition, having been forced to slaughter his pack animals to save himself and his men from starvation, and to cross the Sierra in the dead of winter. He was therefore obliged to push on to Sutter's Fort with all possible expedition, and having stopped there for a few days to recuperate his men and animals, he hastened forward to Monterey. Arrived at that place, then the capital of the Department of Alta California, the Mexican authorities, suspecting that Fremont meditated some revolutionary movement, at once attempted to drive him and his party out of the country. What with resisting this attempt, and the active part he took in effecting the conquest of California, the Great Explorer had quite enough on his hands for the next two years, without thinking about or hunting after gold. That General Fremont actually did make an important discovery of gold, and refrained from giving publicity to the fact, as a few have surmised, is, for obvious reasons other than the above, a hypothesis with hardly the shadow of a reason to rest upon.

GENERAL JOHN A. SUTTER,

The most prominent character connected with the epoch in California history under consideration, and the most noteworthy of all our pioneers, was born in Switzerland, in the year 1805. Bred to the life of a soldier, after distinguishing himself as a captain in the armies of France, he emigrated to the United States. Arriving at New York in

1834, he at once proceeded west, going as far as New Mexico, where he tarried for a time. Not liking that country, and having heard much of California, he joined a party of trappers and crossed the continent, going, contrary to his intention, first to Oregon. From there he took ship to Honolulu, whence he voyaged in like manner to California. This circuitous route was taken to reach his point of destination, for the reason that there were then no vessels running between Oregon and Yerba Buena, while the overland journey was one not easily made. On reaching California, our adventurer at once made his way up the Sacramento River, and there, near the junction of that stream and the American Fork, erected in August, 1839, the fort that afterwards bore his name, he having been guided to this spot by the descriptions of the old beaver hunters, with whom it had been a favorite camping ground, and who had recommended it to him as an eligible site for an agricultural establishment and trading post.

This accomplished, Sutter engaged in carrying out his purpose of growing wheat and manufacturing it into flour for the Russian settlement at Bodega, and of raising horses and cattle on an extended scale. For effecting his plans, a flouring and a sawmill became necessary. The former, a large three-story frame structure, was built only a few hundred yards without the walls of the fort. The nearest place at which timber suitable for making good lumber could be obtained being on the South Fork of the American River, distant about thirty-five miles from the fort, Captain Sutter determined to put up a sawmill at that point. The business of getting out the timber and constructing this mill was intrusted to

JAMES WILSON MARSHALL,

Who, assisted by a small company of white men and Indians, commencing work in the fall of 1847, had the building about completed and ready for running by the end of

that year. Marshall, who was born in New Jersey, in 1812, and brought up to the trade of his father, a coach and wagon maker, emigrated, when about twenty-one years of age, to Indiana, where he worked for a time at carpentering. Leaving that State he sojourned for awhile in Illinois, whence he made his way to the Platt Purchase, in the State of Missouri. Here he engaged in farming and trading, and being tolerably prosperous, made up his mind to settle permanently. But a severe and protracted attack of fever and ague shook this good resolution out of him, and, as a means of escaping the dread disease, he finally concluded to come to California. This determined upon he made due preparation, and joining a company having a train of a hundred wagons, left about the first of May, 1844, on his journey overland. As the safest way for reaching California, Marshall, with a portion of the company, took the route through Oregon, where they wintered, and starting out the next spring, came on to California. Reaching Sutter's Fort in the month of July, 1845, Marshall there made a halt, working afterwards most of the time for Captain Sutter.

When the Bear Flag War broke out Marshall joined the American party, and did good service in the field. Hostilities ended, he returned to the fort and was soon after employed to take charge of the mill-building business, an enterprise that he had some time before strongly urged Captain Sutter to engage in.

FINDING THE GOLD.

In regard to this event there are several versions extant. All, however, agree as to the main facts, their differences relating for the most part to unimportant particulars. Marshall's account of this affair, which has been generally accepted as entitled to credence, is about as follows: Finding the race he had dug below the mill not quite deep enough, he had adopted the plan of hoisting the gate and letting on a full head of water, for the purpose of washing

it out to a greater depth. Walking down the race one morning to see what progress he was making with this work, he noticed a small piece of yellow metal lying in a crevice of the soft granite, which at that point composed the bottom of the race. Picking it up, he began to ponder what it might be, having an impression from the first that it was gold. Its weight and the crude tests he was able to make of this metal—such as pounding it between two stones and finding it malleable—so tended to confirm this idea, that Marshall thought it best not to say much about the matter just then, for fear it might cause the men employed under him to quit work and go to gold digging. But for all that the notion that this metal might be gold gradually spread among the men, who failed not to notice that Marshall continued to look after and pick it up, he having in the course of a few weeks collected from the mill-race several ounces of it. This incident, afterwards fraught with such momentous consequences, occurred on the 19th day of January, 1848—not 1849, as stated in Hittell's excellent and generally accurate work on California—this error in date being a mistake of the printer, and not of the author.

Peter Wimmer, who was with Marshall when he found the first piece of gold, had also gathered a small quantity. Taking a portion of this, his wife, who did the cooking for the men, had subjected it to what was considered a crucial test, boiling it in a decoction of strong lye. As the stuff stood this trial without tarnishing, it was concluded on all hands that it must be gold; and so a feeling of interest began to show itself among the employees about the mill, despite the efforts of Marshall and Wimmer to conceal the real facts and suppress the growing excitement.

Meantime, Marshall having occasion to go to the fort, took some of the metal he had collected along with him, and showed it to Captain Sutter, who proceeded to test it with nitric acid, whereby its true character was fully established. Comprehending the importance of the find, Sutter

accompanied Marshall on his return to the mill, where he soon satisfied himself that the precious metal existed in such quantity as would be likely to work an early revolution in the then existing state of things. Nevertheless he found the men still at work, and affecting to treat the gold find lightly, managed to keep them busied for some days longer, until the mill was fully completed and a small stock of logs gotten in.

By this time the news of the discovery had reached San Francisco, to which place a man named Bennett, one of the hands at the mill, had gone, taking some of the gold dust with him. Among others who happened to see this sample was Isaac Humphrey, who, having formerly worked in the gold diggings of Georgia, as soon as he beheld it not only pronounced it good gold, but expressed the opinion that much more would be found where this came from. Such was the confidence of this Georgia miner in the new discovery, that he left San Francisco about the end of February, and in company with Bennett went up to the mill. Arriving there on the 7th of March he found the men still at their work, none of them having as yet gone to gold digging. After prospecting a little with a pan, Humphrey constructed a rocker, such as he had been accustomed to use in Georgia, and, commencing on dirt taken from the mill-race, washed out from one to two ounces of gold dust daily.

THE NEWS SPREADING, AND ITS EFFECT.

This result of Humphrey's few days' washing put an end to all further operations on and about the mill. Work of every kind was in fact abandoned, all the whites in the vicinity building rockers and betaking themselves to gold washing. Even the mill, which Sutter and Marshall had exerted themselves to complete, for a time stood idle. Getting in logs came to an end; building ceased; everything but gold digging was for the time being suspended. Every where, as the tidings spread, business came to a standstill.

San Francisco was emptied of its adult male population. The American settlers residing in the valleys geared up their teams and set out for the mines, some of them taking their families with them. The rancheros and the vaqueros mounted their mustangs and started for the new El Dorado, driving their pack animals before them. And thus the country, before so quiet and inanimate, was now all astir; the whole population being moved by a single impulse—the eager thirst for gold.

So extensive was this movement, which may be said to have commenced about the middle of March, that there were collected in the mines before the end of the year as many as ten or twelve thousand men. While the most of these were residents of California, many of them came from Oregon, Mexico and the Sandwich Islands, with a few from Central and South America. As population flowed rapidly into the mines, so also was the business of gold gathering speedily extended over a broad stretch of country, having been in the course of a few weeks engaged in at widely distant points. Coming to Sutter's Fort about the middle of March, from his ranch at the head of the Sacramento Valley, Pearson B. Reading visited the site of the new gold discovery. Finding the appearance of the country similar to that in the vicinity of his ranch, he returned home, and taking his domesticated Indians, was engaged before the end of the month washing out gold on Clear Creek, nearly two hundred miles to the northward of Coloma. John Bidwell, another large ranch owner in the Upper Sacramento Valley, having, in like manner, visited Sutter's Mill, returned and went to work with his Indians on the bars of Feather River, nearly midway between Clear Creek and Coloma. Towards the south the gold seeker also made his way, pushing out in that direction as far as the Tuolumne before the season was over; so that mining by the end of the first year was being pursued at intervals along a linear extent of more than two hundred miles.

PIONEER EARNINGS GENERALLY EXAGGERATED.

What followed the discovery of gold in California, is so familiar to most people that it need not here be related in detail. How rapidly the country was populated and its mineral resources developed, is generally well known. Within five years from the occurrence of the above notable event, as many as half a million people had arrived in the State, more than half of whom were still here at the end of that period, the balance having either died in the country or returned to their former homes. While the earnings of these pioneer miners were liberal, they were by no means so large as is generally supposed, as the following statement serves to show. From 1850 to 1854 inclusive, there were at the least calculation 100,000 men at work in the California placers. If they worked but 200 days each in the year—a low estimate—and made on an average \$10 per day, their aggregate earnings would have amounted to \$200,000,000 per year. But the largest sum ever taken out in any one year—1853—did not exceed \$65,000,000; wherefore, estimated on the above basis, the average daily earnings of these men, first in the field, were less than \$4. As it cost then about \$2 per day to live, the net earnings of the men laboring in the gold mines of California were hardly better during these flush times than they are to-day. To make matters worse, we have the fact that a few did, during that period, make very large wages, forcing us to the conclusion that a great many must have made very little; some, as was really the case, almost nothing at all.

The above are good facts to be remembered by those who fancy matters have undergone such radical changes in the California mines, going steadily from bad to worse for the last quarter of a century, and who, to adopt the veteran gold digger's refrain, never have done sighing for a return of "the days of old, the days of gold, the days of Forty Nine." This equalizing results, generally thought to have been so widely unlike, will, of course, be news to many; but there

are the data, and all are at liberty to figure on them in such way as best suits themselves.

BULLION PRODUCT OF CALIFORNIA TO DATE.

According to tables prepared by Dr. Henry Degroot, and published in the Fourth Annual Report of Henry G. Hanks, State Mineralogist, the value of the precious metals produced in California up to the end of 1884, amounted to \$1,186,000,000, of which sum \$26,000,000 consisted of silver. Commencing in 1848, for which year the product was but \$5,000,000, it increased the next year to \$23,000,000, the next to \$50,000,000, and gradually thereafter continued increasing till 1853, when it reached \$65,000,000. After this it as gradually declined for a period of exactly 30 years, having dropped to its minimum, \$15,000,000, in 1883, when it again took an upward turn, and has since been slowly on the increase.

Not until 1872 was much silver bullion turned out in California, the total production made prior to that date amounting to barely \$2,000,000. About 1873, the Cerro Gordo silver mines, in Inyo county, began to yield liberally, and so continued to do for six or seven years thereafter, having turned out during that time some ten or twelve million dollars. About three years ago, the mines of Calico District, San Bernardino County, began to make a notable production of silver, which has since been kept up, the sum turned out to date amounting to about \$10,000,000, the output of several other districts in that section of country being included. That the present annual yield of that region, three millions per annum, can be kept up for a good many years, admits of no doubt, the probabilities being that for some time to come the yearly output will be somewhat larger than this.

It should be stated that in estimating the bullion product of California, the term covers only gold and silver; whereas, in making such estimate for Arizona, Idaho, Montana, Utah, Colorado and New Mexico, the value of the lead and

copper produced is included in the bullion production of these countries. Were the same rule adopted in the case of California, it would swell the so-called bullion output of the State very materially.

THE NEW GOLD ERA.

As already intimated, a new gold era is about to be inaugurated in California. As to this, there cannot be the least room for doubt. It has, in fact, already made its advent, the question now being only as to its more or less rapid progress hereafter. That the business of gold mining in this State will undergo an early and rapid expansion seems inevitable. Though always and everywhere an urgent necessity, this want of more gold is just now especially pressing; these new and insatiate demands for it growing out of the undue production of the other precious metal, the growth of business, the increase of population, and the financial situation the world over. Whatever may happen to silver, there is no where, nor will there ever be any talk about checking the coinage or demonetizing the more royal metal, gold. So little does it fluctuate in value, that it may justly be considered the true measure of all values. It is the one thing that can no where accumulate to excess, and of which there can never be made an over-production. Now, a commodity so steadfast in value, so generally useful, and so universally desired, is a good thing for any people to produce, provided they have even tolerable facilities for doing so.

As in California these facilities are very great, our interest denote that we should make the most of them. Our gold fields, which extend over so many hundred miles, comprising an area of more than eight million acres, remain in a comparatively virgin state, not a tithe of the wealth they originally contained having yet been recovered from them. Of the countless quartz lodes that occur throughout all parts of this auriferous territory, hardly more than one in a hundred has been exhausted, or even so much as thoroughly

tested. The dead rivers, the receptacles of enormous riches, have been but little depleted. The great banks and ridges of hydraulic gravel stand almost intact. The greater portion of the modern river beds have never been disturbed, while hardly so much as a face has been worked on the gold bluffs that overlook the sea. In short, the more enduring repositories of our mineral wealth are only just now beginning to be vigorously attacked, none of them having yet been worked in an exhaustive way. California is capable of supplying this universal want more fully and cheaply than any other country in the world, and that her people are going to arouse themselves and put forth a vigorous effort to that end, admits of no question.

ANOTHER REASON

Why increased attention is likely to be given to gold mining in this State, grows out of the very indifferent results that have attended many of the other pursuits in which our people have of late years engaged. To illustrate their experiences in this particular, and the feeling that has grown out of it, we can hardly do better than quote the following from a letter published not long since in the *Engineering and Mining Journal*, having been prepared for that paper by a California mining man, conversant with the subject in all its parts and bearings.

“As with our attempts at turning the more common metals and the useful minerals to practical account, so have many of our efforts at manufacturing proved disappointing or wholly abortive. With the decadence of the California placers, many of the miners, repairing to other parts of the country, betook themselves to farming, manufacturing, and various other pursuits. As a general thing the cultivators of the soil have done well, most of the manufacturers until recently have also been fairly prosperous. Latterly, however, our manufacturers have begun to experience a new trouble. The completion of three overland railroads has so reduced

freights that goods of many kinds are sent from the East and sold here for less than we can make them for. To meet this competition, proprietors have sought to reduce the wages of their employes, a thing not always of easy accomplishment in a country where an able-bodied man can repair to the mines, with a pretty good chance of getting employment at fair wages. And so, a good many of our manufacturing industries are at a low ebb, with a rather gloomy outlook before them. Our merchants, also, are complaining of curtailed markets, due to the same cause that has so militated against the manufacturing interest. Lumbering, an extensive business in this State, has yielded but small profits to those engaged in it for the past two or three years. And now our farmers are in the dumps. The spring has been a dry one, and the cereal crops are looking bad. The war cloud, that for a time hovered over Europe filled the heart of the honest granger with hope, is now changed to dismay by the prospect of continued peace. No war and no rain, causing a shrinkage of prices and of crops at one and the same time, is to the California wheat-grower an unfortunate conjunction of circumstances.

With so much of discouragement on every hand, with one thing after another slipping from under their feet, our people are beginning to ask what there is they can take hold of that will not miscarry, and in spite of their best endeavors, end in disappointment. Looking about and studying the situation, they remember that California was once a great gold-producing country. Turning their eyes inland, they see a broad auriferous belt stretching for 500 miles along the foot-hills of the Sierra. They know that this belt abounds with rich mineral deposits, comparatively few of which have ever been developed. They know that these deposits, where properly worked, have proved tolerably remunerative, and that for several years past the most of them have paid remarkably well. They know that we have been making great progress in gold mining, correcting most of the abuses

and mistakes once so common; and, reflecting on all this, there is a growing conviction among our people that they may have let go this business a little too soon; that fostered by capital and carefully looked after, it would have yielded better returns, perhaps, than some of our other much-vaunted industries. And in this they are probably right. Quartz mining would seem to present as good a field as any open for the investment of money in the State—a fact that our home capitalists have not failed to appreciate, some of them having kept their agents constantly on the look-out for properties of this kind. This increased confidence and activity in mining is not altogether of recent date. It began to manifest itself four or five years ago, having now become so pronounced that many look upon it as marking the advent of a new gold era in California; contending that the business if not restored to its former supremacy, is sure to become in the course of a few years, one of our most substantial industries.

What has tended greatly to improve the prospects of mining here by winning to it the support of the better classes of the business community, is the almost total cessation of stock gambling. Dealing in Washoe shares is still kept up in a feeble and fitful way, for the Comstock giant dies hard. Other shares are quite dead, as denoted by the failure of attempts recently made to galvanize the cadaver.

Confidence in California gold mining has, furthermore, been much strengthened of late by reason of the many discoveries of valuable quartz lodes that have been made in different parts of the State; these discoveries having occurred not in new territory, but generally in old and once populous districts, sometimes in localities that, having been exhausted of their surface deposits, had come to be neglected or wholly abandoned."

That the statements and opinions above expressed will be endorsed by many of our manufacturers and machinists, and even by some merchants and farmers, there is good

reason to believe, the condition of things here having in this respect undergone no improvement of late.

But this new gold era, while it is going to greatly stimulate the business of mining, and add vastly to our present product of bullion, is not going to restore former conditions, nor bring with it a return to the old implements and methods; these are obsolete. The day of the digger has with the shallow diggings passed away forever, and the day of the capitalist has come. Mere muscle will no longer suffice. The brawny arm must be aided by skill and money, or little can be accomplished. The pan and rocker must give place to costly and complicated machinery, and operations in most cases be conducted on a large scale. Not only must skill and capital be made auxiliary to mining, but science as well; all that close investigation and careful experimenting being practiced in connection with it, that are observed in the conduct of our great manufacturing industries, where a full corps of experts and chemists are kept constantly employed. Although we in California have not as yet done much towards so perfecting the business of gold mining, all this will, in good time, be brought about, now that we are becoming conscious of its importance.

QUOTING AUTHORITIES — THE MINING AND SCIENTIFIC PRESS.

That we do not speak without warrant in predicting for the business of gold mining in California an immediate and notable expansion, we reproduce a number of articles from leading journals in this State, some of which are published in the mineral regions, all of them being largely devoted to the mining interest. In acknowledging, as we have already done, our obligations to the *Mining and Scientific Press* for much valuable matter used in this book, we deem it but just that a few words should here be said in regard to the valuable service that journal has, during its long and useful career, render this and every other branch of mining

on the Pacific Coast. With the month of June last, the *Press* completed its fiftieth volume, the paper of late years having consisted of two volumes per annum. During its earlier history, a volume comprised the issues for an entire year; wherefore the *Press* is considerably more than quarter of a century old, its age approximating thirty years. During all this time, it has been distinguished alike for editorial industry and ability and the sound business judgment that has marked its conduct throughout. It has moreover, always stood in the front rank of pure and honorable journalism, having never lent itself to the furtherance of any questionable scheme, or sought to make money by other than fair and reputable means. It has shown itself the persistent enemy of stock gambling and every form of illegitimate mining, ever laboring to discourage wild speculations, and introduce a better code of ethics into the business. If, for duty so ably and conscientiously performed, the proprietors have reaped an ample reward, it is no more than they well deserved. If the *Press* has not the largest circulation of any mining journal in the world, it ought to have, for there is hardly another that can compare with it in point of well directed enterprise and practical usefulness. No miner or person taking an interest in mining, can afford to be without this paper, as it keeps the reader thoroughly posted in all that relates to this industry, both at home and abroad. If an important mineral discovery takes place; if any new machine, invention or process is announced, or additional mining law promulgated, the same is in due time reported and its merits commented upon in the columns of this journal, every number of which, besides ably written editorials on all leading topics, contains a full and well digested summary of mining news from all parts of the country.

The editorial and business staff of the *Mining and Scientific Press*, omitting numerous subordinates employed in every department of the paper, consists of Alfred T. Dewey, manager in chief, Warren B. Ewer, senior and consulting editor, and Charles G. Yale, son of the late eminent jurist,

Gregory Yale, junior and acting editor—each of these parties being by reason of special education, long training and certain natural aptitudes, peculiarly fitted for discharging the duties pertaining to his position. Mr. Dewey, who largely shapes the general policy of the paper, is everywhere recognized as a man of liberal views and advanced thought, keeping both this and the several other publications subject to his control, well abreast this age of enlightenment and progress. In a work devoted to the subject of mining, it has seemed to us not out of place that thus much should be said of a journal that for so many years has shown itself the zealous and intelligent advocate of the business; we being of those who believe, not only that the "laborer is worthy of his hire," but that, besides his mere wage, he who has so "borne the heat and burden of the day," is entitled to some little commendation as well.

Recurring now to the subject with which we set out, we reprint the following editorial, taken from the *Mining and Scientific Press* of May 7th, 1885:

"LET THE WORLD MAKE A NOTE OF IT.

It may be well for people abroad to understand, what is so well understood here, that we are on the eve of a new gold era in California. We speak advisedly; we are not writing at random, but have the data at hand to warrant what we say. There is likely to arise here, and even exists at present, such a condition of affairs as must soon impart renewed vigor to and insure for the business of gold mining a long and prosperous life in this State. The facts on which we found this opinion are indisputable—are so tangible and certain, that they may safely be adopted as the basis of any, even the most extended enterprise connected with this branch of mining. We do not say, for we do not believe, there is going to occur in California any great excitement or so-called "boom" in connection with gold mining, either placer or quartz. Of this sort of thing we have had too much

already, and it is gratifying to think that its day is well nigh over. As our miners have got done with stampedes and rushes, so have investors got done with premature expenditure and wasteful speculations, and when we speak of increased activity in mining, we only mean that our people, finding that the business rightly conducted can be made to pay, are for that reason engaging in it more largely than ever before. If mention is made of a new and promising mineral district, it is not meant that men can repair to such district and there make money without the exercise of ordinary business sense; but only that there exist there latent opportunities, which, to be made available, require the intelligent application of labor and capital. When the *Rural Press*, our confrere in the agricultural world, describes the orange and lemon orchards of Los Angeles, it does not mean that nature has produced either, only that the soil and the climate of that region, being so extremely favorable to the growth of these citrus fruits, has induced man to come in and here plant the same extensively. So of our mineral resources. Nature has placed them in the mountains under conditions that greatly tend to encourage their development. Still, man must come in and do his part, the same as in the growing of fruit or grain.

At one time the agricultural resources of California were thought to be of a very low order. Now they are known to surpass those of any other part of the world. A few years since gold mining in this State, having been long on the wane, was supposed to be nearing its end. To day it looks differently—looks as if the business were about to take a new lease of life. Gains pervade every department of this industry. We have gained in the matter of economizing labor and expenditures, in the extraction and working of the ores, and in the finding of new and more thorough exploration of old deposits, the latter amounting often to a rediscovery, in that the extent and value of these deposits have greatly exceeded all previous expectation. Grounds traversed by trails for thirty-five years, and which during all this time

attracted little or no attention, are now found to be rich in gold bearing quartz lodes or other form of auriferous deposit. The hydraulic banks along the Klamath, worked for many years, and generally in a small way, turn out to be in themselves a great gold field, from which millions might annually be taken out without working them in an exhaustive way. The gold beaches and bluffs along our sea coast, nearly abandoned for years, are likely to become very soon once more the theater of active operations, while the tailings that have accumulated in such quantities along the interior river channels seem destined also to be moved and reworked with profit.

Looking up and down the principal mineral belt of the State, we find new mining centers springing up at different points along it. At its end a silver producing region has sprung into existence during the past three years, which is turning out that metal at the rate of \$5,000,000 per annum, with a prospect of doubling this production in the early future."

In an issue of the *Press* of a somewhat earlier date, the following editorial article occurs:

"AN INCREASED GOLD PRODUCT IN CALIFORNIA.

On account of the very low price of lead and copper and the discount on silver, there is now more of a demand for gold-mining properties than has been the case for some years. Attention is therefore being directed to mines in this State, and it is probable that we will hereafter experience an increase in the gold product rather than a decline.

The reasons for expecting an increased gold product may be briefly stated as follows: First, we have the auriferous resources to warrant an early and very great expansion of the gold mining industry. The present output of this metal could, through the supplying of additional plant and the opening up of new mines, be doubled with profit in less than two years. Hardly more than one paying quartz lode

in ten, known to exist in the State, has yet been brought into a productive condition. There is, to be sure, renewed interest and much activity being manifested at present in this branch of mining, and on this fact is based in large measure, our expectation of an increased gold production in the early future, there being good reason to anticipate for these efforts a generally favorable issue.

As we have auriferous quartz in such abundance, so also does California contain a great extent of unworked placer deposits, these latter having been exhausted only where they could be most readily reached and easily worked; such as the shallow prairie diggings, the gulches and ravines, including some portions of the river beds and most of the bars along the streams. This class of deposits have for the most part been worked by methods and appliances so simple and inexpensive that it is a misnomer to call this kind of operations mining at all. But having served their purpose, removing and working the material most easily reached, there still remains in this State, besides the innumerable quartz lodes, thousands of acres of hydraulic gravel banks, hundreds of miles of the old Pliocene channels and long stretches of the long river beds untouched or but little worked, to say nothing of dry diggings, virgin, because no water has ever been brought upon them, or the deep-lying basins that could not be worked for want of drainage. The time is coming, too, when the immense bodies of tailings that have accumulated along the rivers and gulches of California will be rehandled with profit, and the auriferous sands that stretch so many leagues along her sea coast will be turned to practical account. To fully occupy the field here opened to capital and labor, will require a great many years; to exhaust it of its resources, will be the work of many generations, perhaps of centuries. The enduring qualities of quartz mining in California find illustration in the Sierra Buttes property, which, after being steadily and profitably worked for more than thirty years without any sign of exhaustion, is yielding now more ore than ever

before. Grass Valley, where quartz first began to be extracted and where this class of mining has been prosecuted for thirty-three years with energy and persistence, is to-day the most prosperous quartz mining district in the State. The Empire mine, which turns out annually a million in gold, is situated on that section of the Mother Lode that has been worked extensively and without intermission for twenty-five years, these being only a few examples that might be cited, all of similar import.

That a good deal of money has been heretofore lost in gold mining operations in California, cannot be denied. But such losses, while far less than have occurred in many other countries, are not going to happen to any great extent in this State hereafter. As before remarked, we have learned here the business of gold mining pretty thoroughly. We have brought our processes, methods and machinery to great perfection. Profiting by experience, we avoid now many of the mistakes of the past, practicing an economy, caution and system that only a few years ago were in most cases disregarded. In these improved conditions, investors have assurances of larger returns and better general results in the future."

QUARTZ OPERATIONS.

From the Grass Valley *Daily Union* of January 17th, 1885, a paper published at the oldest and most active quartz mining center in California, we extract the following remarks, which, besides being truthful and timely, are to be commended for the spirit of candor that pervades them:

"Although hydraulic mining has been placed under a cloud by the litigation against it for the past few years, and unfavorable decisions of the courts, and investment in and development of that character of mining property has virtually ceased in this vicinity, yet the quartz mining industry has been growing apace in California, and to-day stands on a better footing than at any previous time in the history of

the State. In saying this we do not overlook the fact that quartz properties once of note have now no standing, and that all over the mining regions are to be found partially developed quartz mines that are idle, or prospect holes that show where money and labor was thrown away. We know that there have been many and costly failures in quartz mining, and from the fact that all quartz veins cannot be prolific gold-bearers, there will be failures in the future; yet experience has been a good teacher, and imparted knowledge where ignorance once existed, and improvements in machinery and better knowledge of working ores has done much of late in giving a reliability to quartz mining that it did not possess in earlier years, when there was a general inexperience as to the characteristics of mineral-bearing veins, and a woeful lack of knowledge in properly manipulating the ores. Early quartz mining was attended with great expense, and only because of the richness of many veins was it possible to obtain a profit when there was such an absence of skill and economy. Quartz miners have learned, however, that gold-bearing veins are not rich as a rule, but are yet sufficiently reliable, in a majority of cases, to yield a profit if the same prudence and intelligence is used as is necessary in other trades and industries. This has been so well demonstrated that of late years quartz mining has grown into much larger dimensions than is generally supposed, not through the agency of corporations that figure in the stock markets, but mainly through local or individual enterprise, until there are now in all parts of the mining regions quartz mines that are being worked regularly and with a profit, but whose output is not a matter of publication any more than would be the details of other private business. It is but necessary to point to the fact that quartz mining, which has always been an important business in Nevada County, has grown much in two years, and a number of new enterprises of the kind are now being entered upon. Sierra County, which is ribbed with quartz ledges, long neglected, is coming to the front as one of the richest and most impor-

tant quartz mining regions in the State. Plumas and Shasta have now profitable quartz mining where a few years ago little was doing. Quartz mining has made substantial advances in Placer and El Dorado Counties, and Amador County still holds the second place to Nevada, while in Calaveras and Tuolumne the dead placer camps are taking on new life from the influence of the stamping batteries. In the far south, in the Calico country, a rich and extensive field is being opened, while right here at home, in the Washington District, many quartz discoveries of a valuable and permanent kind are being made. The growth of quartz mining in the State has not escaped the attention of mining men, and is having the effect of lessening the disposition to seek regions which have their greatest glamour of richness the more distant they may be, and cause them to invest in California mines, which, though not promising such rich returns, yet are found to be reliable if intelligently and economically worked. With the present year there will be a decided advance in the quartz business, and the future output from this source of mining is destined to show a regular and healthful increase."

The *Tidings*, published in the same place, descanting also on the subject of gold mining in that vicinity, proceeds after this wise:

"Just now the mining outlook is especially flattering in this district, and all feel good over it. Men who have gone away from here to seek their fortunes elsewhere, are gradually coming back, and every dollar they have saved up they are willing to place in the numerous ledges of Grass Valley, saying that the district has never been half prospected, and that when the ledges are developed here, we will have the best mines that have ever existed on the Pacific Coast. It is not going to take long to fulfill this prophecy."

The *Transcript*, another journal giving large attention to mining affairs, published at Nevada City, also a notable mining locality, comments on the outlook in that neighborhood in a similar strain, predicting for both placer and

quartz operations in that part of the State a steady progress and a prosperous future.

SOME NOTABLE PERSONAGES, SCENES AND EVENTS.

As a fitting introduction to our main subject, we present here some additional remarks about General Sutter and



GEN. JOHN A. SUTTER

James W. Marshall, two of the most conspicuous characters connected with the discovery of gold in this State, accompanying the same with well executed likenesses of these men We also present cuts of Sutter's Fort and the Mill where gold was first found, with some account of these memorable structures, and the fate that has befallen them. For several of these cuts, all of which are well executed and true to nature, we are indebted to the courtesy of the Sac-

ramento *Daily Bee*, a paper that has ever shown much enterprise in this direction.

GEN. JOHN A. SUTTER.

The cut here given conveys a good idea of General Sutter as he appeared thirty five years ago, being then a little more than 50 years of age. In figure he was of medium height, rather stout but well built. His head, as will be seen, was of good size, evenly developed, and at the time we speak of, slightly bald in front. His features were regular, his complexion fresh and healthy, his open and frank countenance wearing a friendly and even smiling expression that contrasted with his well cut and rather firm mouth. His manners, though highly polished, denoting his military life and training, were exceedingly pleasant, all, even the most humble, being made to feel easy in his presence. He wore his hair cut close, with short side whiskers and moustache. He dressed neatly, always in a blue frock coat and pantaloons, wearing a cap of the same color. For a further description of this the most illustrious of all our historical characters, his personal habits and appearance, some of the leading events of his life, and his demise in the City of Washington five years ago, we again have recourse to the pamphlet of which such free use has already been made, and from which we extract the following on this subject:

"General Sutter was in many respects a very superior man. His intellectual endowments were of the highest order. Physically he was equally favored, being well proportioned and otherwise of great bodily perfection. He was highly educated, first in the schools and afterwards to the profession of arms, the versatility of his talents being manifested by the creditable manner in which he acquitted himself in both these callings. His aptitude for the acquirement of knowledge is evinced by the facility with which he read and spoke four different languages. He naturally possessed the instincts, and always, even in the midst of his

rude surroundings, managed to preserve the manners and bearing of the gentleman, soldier and scholar. And yet, with so much to lift him above the common level, he was utterly without ostentation or vanity. Though learned and well acquainted with books, he was thoroughly practical, showing on all occasions the sagacious, enterprising man of affairs. He was the first to introduce anything like new ideas and modern improvements into California. Though he did not put up the first flouring or the first saw mill in the country, he was the first to erect establishments of this kind with a view to manufacture flour and lumber for the general market. He was the first to engage in the growing of wheat and the cultivation of the land on an extended and systematic scale.

"Gen. John Bidwell, himself one of the earliest, as he is also one of the noblest of the pioneers, bears efficient and kindly testimony to the high qualifications, personal merits and rich deservings of Gen. John A. Sutter. In a letter written not long since to Capt. Wm. F. Swazey, and now in the possession of the Society of California Pioneers, Gen. Bidwell, among other things, remarks as follows, his statements being here somewhat abbreviated: "General Sutter, when I first saw him in 1841, seemed to me the grandest man I had ever met with. Of a fine presence and agreeable deportment, he spoke German, French, Spanish and English fluently and well. As a conversationalist he excelled, being at home in the most refined and intelligent company. Yet he was not the least egotistical, but listened respectfully to every one, the high and the low alike, and by his courteous manner making all with whom he came in contact his friends. He was a man of the purest honor and the strictest integrity. The California officials had such confidence in all he said or promised that when he sought land for a colony, they readily granted all he asked for, and immediately put him in possession of the same. All who knew were ready to trust him, the Russian Fur Company having sold to him at the stipulated price of \$100,000, but wholly on

credit, their entire property at Fort Ross and Bodega. Becoming jealous of his growing power and exasperated at the partiality he manifested towards the American settlers, the Mexican authorities in California began at last to threaten Gen. Sutter, going so far as to talk of expelling him from the country. When things had reached this pass Sutter advised these intermeddlers that they had better refrain from further threats of this kind, as he was in a position to successfully resist any interference with his rights, and that if these menaces were repeated, he might himself be constrained to act on the offensive, his main reliance in case this became necessary, being upon the small number of Americans, not over fifty or sixty, then living in the vicinity of the Fort or settled in the Upper Sacramento Valley. This defiant attitude of Sutter towards the departmental authorities having been reported at the national capital, Mitcheltorena was despatched to California with 500 troops, for the purpose of crushing out this growing spirit of insubordination, and, if need be, driving every American, Sutter included, out of the country. So far from accomplishing such task, this doughty commander, who was also appointed Governor, found it expedient to make friends with Sutter and his adherents, affairs having ultimately taken such turn that he who had come to expel others was himself expelled from California."

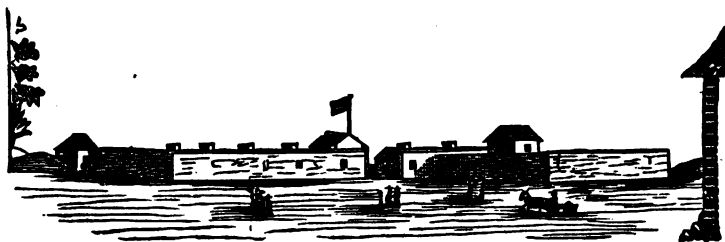
Continuing, our worthy informant goes on to remark upon the boundless generosity of General Sutter as manifested towards all who, from sickness, misfortune or other cause, required assistance. No man, rich or poor, whatever his position in life or his nationality, ever applied to Sutter for aid in vain. Whoever asked received, nor did he always wait for the suffering and needy to come and make their wants known. When he heard of an incoming immigrant train snow-bound in the mountains or suffering from want of food, he at once sent them provisions on pack animals, in charge of trusty men, these relief parties going sometimes far into and even quite across the Sierra on these errands of mercy.

All who arrived at the fort destitute were supplied according to their necessities, and this without any charge being made or anything said about future compensation. There being at that day no hotels or public houses in the country, all who came to Sutter's establishment desiring to stop were there entertained as free guests, however long they chose to remain. When General Bidwell and his companions entered the country, Sutter, hearing that there was a party coming in who were in need of provisions, forwarded them supplies while they were yet in the mountains, more than a hundred miles away.

It was by noble and disinterested acts like these, running through a series of years, that General Sutter managed to so attach to his cause the entire foreign population, and even many of the native Californians, that when the final outbreak occurred the conquest of the country became an easy matter. That the subjugation of California did not cost us a long and bloody struggle is largely due to the course pursued by Sutter and his coadjutors prior to the commencement of active hostilities.

As a partial recognition of obligations for the service so rendered, the Legislature of this State some years ago voted General Sutter a monthly stipend of \$250, limiting the same to a certain number of years. On the expiration of this period this subsidy failed to be renewed, nor have the efforts since made by some to procure a re-enactment of that law ever met with success. As a consequence, this fast friend of American institutions and interests in the Far West, this planter of the new civilization on the Pacific Coast, the hardy explorer and typical pioneer, worn out with toil and weary with waiting, passed into the sere and yellow leaf of life, his last days pinched with want and clouded with sorrow. On the 18th day of June, 1880, the eventful career of the Switzer soldier was brought to a close in the City of Washington, whither he had gone several years before, in the hope of obtaining from Congress some slight compensation for the property of which he had been so unjustly deprived,

and the sacrifices he had made in behalf of republican institutions and the American people. Through neglect and delay the ingratitude of California was paralleled by the injustice of Congress, which body, always professing a willingness to do justice to General Sutter, temporized until it was too late. Several members of the House, however, attended his funeral, and there is even a talk of having a stone placed at the head of the old man's grave. It would not, indeed, be at all strange if, after so starving him to death, California should take measures to erect a grand monument over his remains. This is the way the world often treats its heroes! The body of General Sutter, who was seventy-five years old at the time of his death, was taken to the little town of Letitz, in Pennsylvania, where his daughter resides, and there interred in the humble graveyard of the place. By his side his aged and estimable wife, since deceased, has also been buried."



SUTTER'S FORT AS IT APPEARED IN 1849.

The above cut shows Sutter's Fort as seen in 1849, and very nearly as it appeared when completed by him in 1840, the place having in the interim undergone but little change. It stood in what are now the easterly environs of Sacramento City, where the little that remains of it is still to be seen. It was located on the left bank of the American Fork, a few rods from the stream, and on a swell of land slightly elevated above the surrounding plains. Though not in a military sense at all formidable, it was sufficiently so to resist assault by the aborigines of the country from whom alone was there any reason to apprehend attack. The structure,

built wholly of adobe, was a parallelogram 300 by 400 feet. The outer walls, some 20 feet in height, had towers at two of the corners, with embrasures and loop holes for firearms. In the centre of the square stood a large two-story building, the residence of the proprietor; the store-rooms, shops, graneries, Indian quarters, etc., being ranged along and inside the walls, with openings only on the main square. There were two principal entrances, one on the north and the other on the south side, each supplied with strong gates, always closed at night; an armed sentinel being also kept stationed here.



JAMES W. MARSHALL.

After the discovery of gold, General Sutter, having been despoiled of his property, finally left the fort, which thereupon being neglected, fell into a state of decay. Gradually the walls crumbled down, the gates were removed, being used with other portions of the woodwork for fuel; and thus

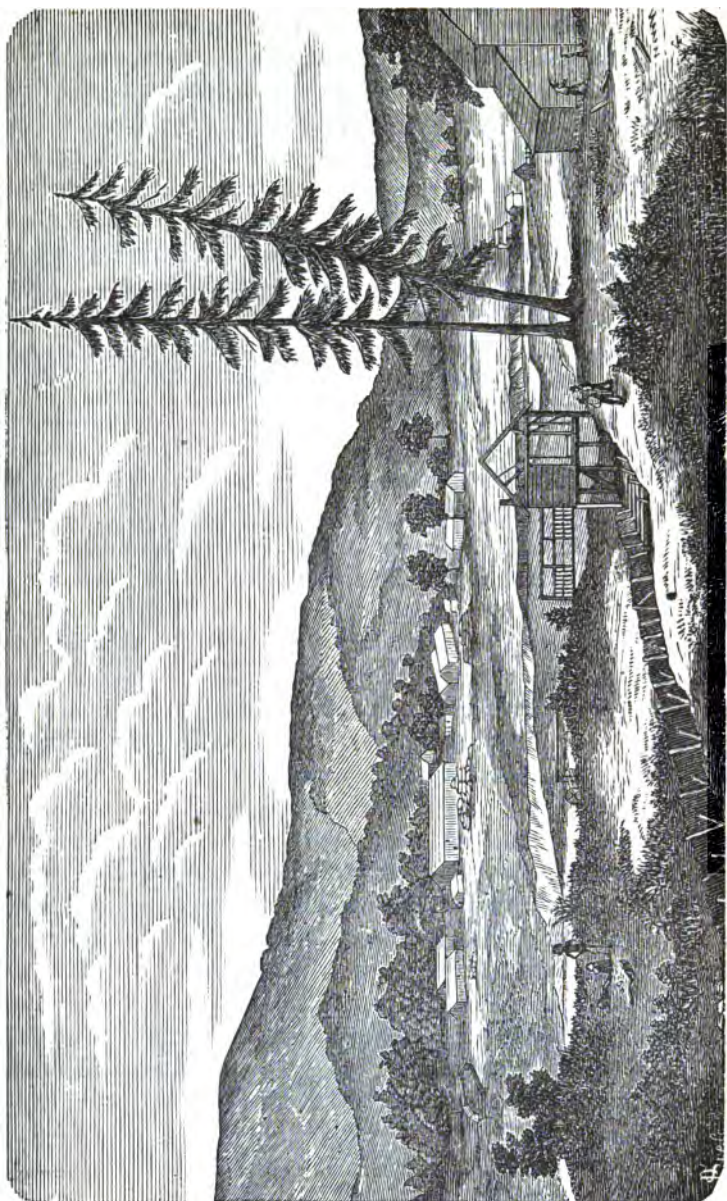
year by year some portion of the establishment disappeared, until now only the central building, with its shattered and windowless walls is left.

JAMES W. MARSHALL.

A better portrait of Marshall, the discoverer of gold in California, than is here given it would not be possible to obtain, he being here represented as he appeared only a year or two ago, since which he has altered but little. The likeness is, in fact, so good, that a person who had never seen the man, would, were he to meet him, be able to recognize him from this picture. For his age, being now 73, Marshall is well preserved—both mentally and physically, being able to recall events and dates with much distinctness, and getting about almost as well as ever. To what has already been said about this notable character, the following from *Recollections of California Mining Life*, may be added.

“Dating from the time of the gold discovery, the story of Marshall’s life is briefly told. Having during the few months that followed that event, collected considerable gold, some of it being a sort of tribute paid him and Sutter by the Indians, he concluded to leave the diggings, which he did. After a short absence he returned, and again went to mining, at which he afterwards met with only moderate success. Tiring of this business, he betook himself to fruit and vine growing, on a patch of land that he had always occupied near the mill, or Coloma, as the town, that had here grown up had come to be called. Planting only trees and vines of choice varieties, Marshall had here in the course of a few years, the best nursery and vineyard in that section of country. Having lived here for some time in a comfortable sort of way, he parted with this place, and afterwards does not seem to have had any permanent home, or to have remained long in one place. For a time, and up till a year or two ago, he was living in a cabin at Kelsey’s Dig-

gings, an ancient mining camp on the opposite side of the river, a few miles above Coloma. Latterly he has been sojourning elsewhere in the central mining counties, visiting occasionally San Francisco, Sacramento and some of the larger towns. He is now quite poor, but does not appear to worry over his present condition, nor the outlook for the future. By reason of his former history, and many good personal qualities, he is generally well liked, and receives everywhere a cordial welcome. Though an unlettered man, Marshall is intelligent and thoughtful, and, between his reminiscences and a large fund of general information, is capable of not only entertaining a promiscuous crowd, but also of interesting persons of mental culture. He is odd in many of his ways—in some peculiar to the verge of eccentricity—being little governed by the opinions of others, and quite indifferent to the etiquette of conventional life. Taken altogether, he is an agreeable sort of fellow, and not unsociable, once his confidence is gained—the which is not an easy matter, the scurvy manner in which he fancies he has been treated by the State of California in refusing to properly reward his services, having rendered him somewhat misanthropic and suspicious of strangers. It would really seem as if the State might make some little provision for the old man in his declining years, seeing he is so very needy, and was the actual discoverer of gold, an event generally conceded to have been a great public blessing. To Hargrave, the discoverer of gold in Australia, there was given a donation of \$75,000, and simple justice requires that something should be done for Marshall. For a time he did receive from the State of California a subsidy of \$100 per month. But the period for which this was to be continued having expired, the Legislature refused to renew it, fearing its further payment would be too great a strain on the financial resources of the State."



SUTTER'S MILL, WHERE GOLD WAS FIRST DISCOVERED.

In this picture, copied from a painting by Charles Nahl, we have a good representation of the far-famed Sutter's Mill, as it appeared in 1849, and for several years thereafter.

Having already made mention of the more interesting incidents connected with the history of this mill, it only remains to be said that it, like the baronial establishment at New Helvetia, has become one of the things of the past. But if the Fort is so nearly gone, the very site of the mill has been razed. The rude structure itself has not only disappeared, but the ground on which it stood has been literally swept away. The dam, the race in which Marshall picked up the first piece of gold, the big pines standing fast by, as shown in the picture, are all gone, and in their place only piles of white bowlders glisten in the sun! So changed everything, that but for the river, flowing as it flowed before, it would be difficult now to identify the exact spot formerly occupied by Sutter's mill. Nor let the relic hunter come here seeking mementoes or reminders of the past! The iconoclastic pick of the miner has spared none of these—not a stick or foundation stone or slab or splinter has been left. All is extinguished. Even the old town of Coloma, standing hard by, has been nearly all washed away, the ground it covered having been sent down the South Fork to swell the tide of slums that vexes the farmers below, and which, beginning when Marshall here washed his first pan of dirt, has gone on increasing ever since, nor judging from present appearances, is it likely soon to cease.

Having thus disposed of the more noteworthy characters and events connected with the pioneer history of gold mining in California, we come now to say a few words explanatory of

THE MECHANISMS AND STYLES OF MINING HERE MOST IN VOGUE IN EARLY DAYS.

As the business of gold mining as pursued in this State divides itself into a number of different branches, accord-

ing to the nature of the deposits to be worked, and the implements and methods employed in working them, it becomes proper that these several branches be taken up and described in the chronological order of their occurrence. As, however, the modes and appliances here first in use have now become nearly obsolete, having been superseded by others of a more effective kind, we need at this time do hardly more than allude to the same in a brief and cursory



READY TO START ON A PROSPECTING TOUR.

way; the more especially as we have taken pains to illustrate the most of them with aptly designed and well executed cuts, which, addressing the eye, explain these utensils, customs and modes better than any written or spoken words could do. The first of these cuts shows the miner outfitted and equipped, ready to start on a prospecting tour. His

blankets on back, his pick and shovel over his shoulder, the indispensable pan under his arm and his coffee pot in his hand, enough "grub" for the short trip he contemplates being wrapped up in his blankets. This is one of the early day prospectors, who is starting out to hunt for bar or gulch diggings, and does not therefore expect to be



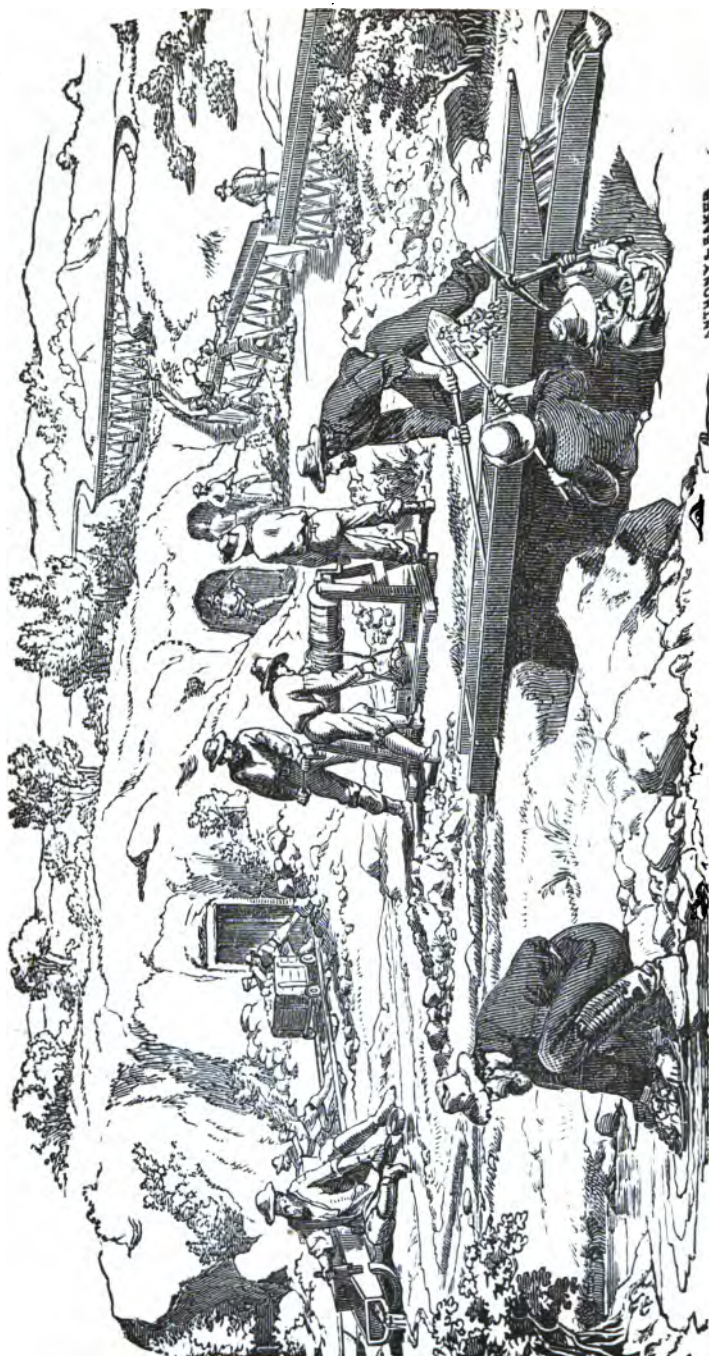
PAN WASHING.

away from camp more than a day or two. Later, when longer trips became necessary, the prospector was obliged to provide himself with pack animals to carry his provisions, tools, tent, etc., his absence on these trips often extending to several months, during which he traveled for hundreds of miles through the mountains.

The most simple and primitive style of gold gathering practiced is pan washing. Having filled his pan with auriferous earth, and placed the same beneath the surface of the water, the operator, by a series of adroit movements, manages in a very few minutes to separate and float off the earth, gravel, and other worthless material, leaving only the gold, mixed perhaps with a little black sand behind. Judging from the contents of his pan, the nugget held in his hand, and his satisfied expression of countenance, it has been the good luck of our miner to strike some exceedingly rich diggings. If now, he be a man of good habits, working hard and saving his earnings, he will, in the course of a few weeks, or months, at most, be able to make his "pile," and "go home to the States."

The Mexicans and miners coming from other Spanish-American countries, brought with them the batea, a shallow wooden bowl, which they used for gold washing. Being for this purpose superior to the pan, this utensil would have been employed by all, could it have been obtained. The pan first in use was the common milk pan, its upper edge being sometimes strengthened on the outside with heavy wire, or otherwise supported. These soon gave place to pans made of sheet iron, smaller, but much stronger than those manufactured of tin. While neither the pan nor the batea are now much used for gravel washing, the latter is still retained by the prospector, being also constantly employed by the assayer, the mill-man, and the metallurgist. Melville Atwood, the well known mining engineer, after much study and experimenting, has succeeded in bringing the batea to an unwonted degree of perfection; so improving the shape and the material of which it is made, as to produce an implement of great use in making mechanical assays, and other tests, where extreme exactness is not required.

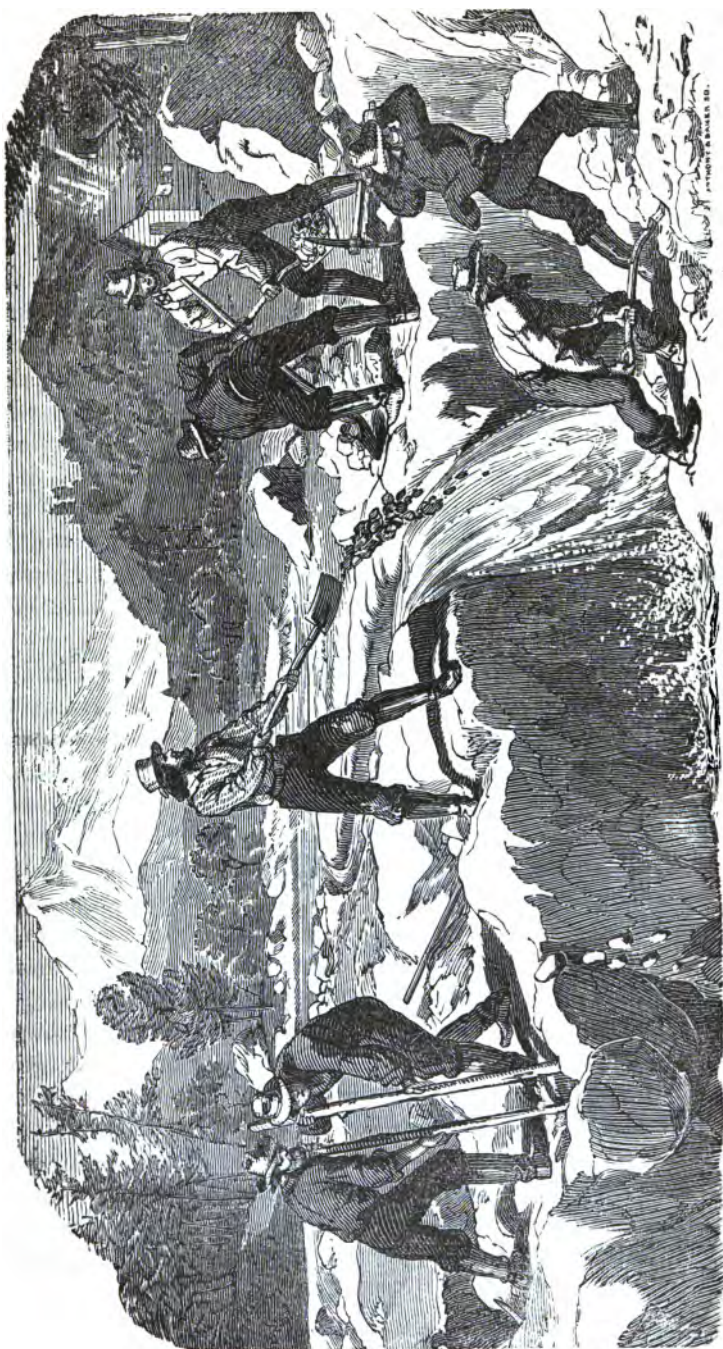
The next picture introduced to our notice exhibits a more varied and animated scene than that last presented, showing up, as it does, several different forms of placer mining, all in active operation.



FAN, CRADLE, LONG-TOM, AND SLUICE WASHING.

In the foreground, on the left, he of the pan reappears, engaged now in actual dirt washing, the result of which he regards with intense interest. Nearly opposite and a little further back is seen a miner washing with a cradle or rocker. Having filled the hopper with dirt, he is now in the act of imparting motion to the machine with one hand while he dips up and throws water into it with the other. This dirt, the artist would have us understand, came from the tunnel in the rear. There are drift diggings under the ridge into which this tunnel has been run, and a couple of miners are seen pushing a carload of dirt over the tramway laid down in this tunnel, and dumping it within easy reach of the bearded chap operating the rocker. The three men at the windlass to the right, are putting down a shaft, prospecting for drift deposits, supposed to exist at that spot. If they succeed in striking pay gravel, they will bring it to the surface in buckets, as they now do the dirt taken from the shaft they are sinking. There are indications of an old channel there, and these hopeful fellows are going for it after the manner represented. In front of this group are three others working a long-tom, the next labor-saving machine following the rocker. Two of the number are shoveling dirt from a pit into the "tom," the third being engaged in keeping the stuff duly stirred up after it gets there. Below the "tom" is set a riffle-box supplied with quicksilver to aid in catching the gold. In the background we have a company engaged at hand or shovel sluicing, as the business is variously called, a ditch and flume built for introducing water into the diggings being seen in the distance. This style of operating differs not much from that carried on by the long-tom, its predecessor, only that the sluices or troughs into which the gravel is thrown to be washed are greatly extended, the riffle-box being also dispensed with.

In the picture opposite we have a view of—

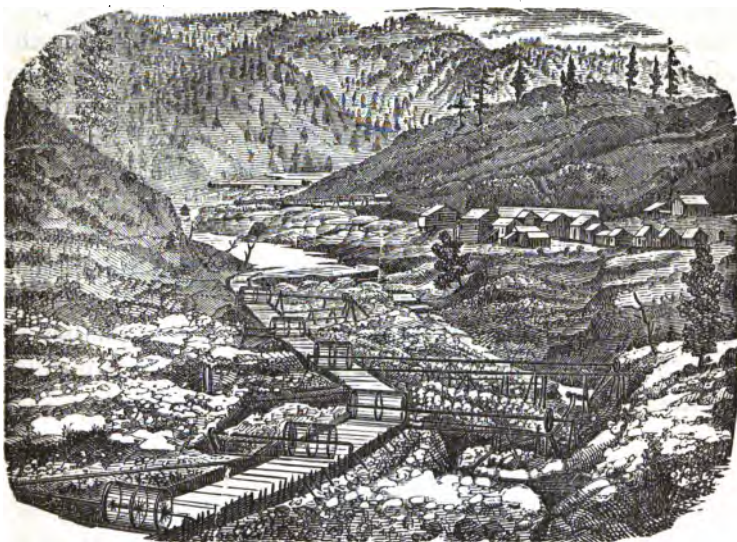


GROUND SLUICING.

A style of mining not much practiced except in the winter, when the ground is soft and water abundant. It consists in digging up the auriferous earth and throwing it into a gulch or channel formed for the purpose, and down which there rushes a heavy current of water. In washing by this method no sluice-riffles or other gold catching apparatus is used, the metal being left to settle on the bedrock, from which it is collected when the run is over. It is plain to be seen from the movements of these men, that no time is to be lost. They have now free water, and plenty of it. But it may not last long, and may even give out in the course of a few days; wherefore they must make the most of it while it continues. Day and night, with crowbar, pick and shovel, they ply their work, these two sturdy fellows on the left prying off great chunks of earth and pitching them into the seething torrent below. With equal vigor do the others wield their implement, gravel, cobbles, great boulders, and even trees, if they come in their way.

A branch of the business engaged in at one time along nearly all the gold-producing rivers of California, and still carried on to some extent along the most of them, the heaviest operations of this kind now being prosecuted on the Salmon, Scott and Klamath rivers, in the northwestern part of the State. By this mode of mining, the water is turned from the channels of the streams and their beds dug up and washed for the gold they contain. Where only a portion of the river bed is to be so reclaimed and washed, this is effected by constructing a coffer-dam, a method of procedure practiced now mostly by the Chinese, and called wing-damming. Where the entire channel is to be worked, a dam is thrown entirely across the stream, and the water turned out into a flume or race laid down on one of its banks, and which, being of sufficient capacity to receive the entire flow of water, conveys it below the section of river bed to be drained, and there returns it to the channel. The flume, constructed of heavy lumber, is shown in the picture on the left, with the dam at its head, the portion of the river bed

to be drained appearing on the right. In the flume are placed a succession of water-wheels, revolving on long shafts that extend over the pits dug out, and to the ends of which are attached pumps that keep these pits free from sippage water. As soon as the river has been turned into the flume, the miners commence digging up the bed, the gravel being thrown into sluices and washed, while the boulders are lifted out of the way with derricks and piled up on the bed rock, this having been first cleared away to receive them.



VIEW OF RIVER BED MINING.

As this part of the business cannot be entered upon till the water has fallen to a low stage, which seldom occurs till mid-summer, the working season vouchsafed the river bed miner is short, wherefore he has to make the most of it while it lasts. As many men are put to work as can be employed to advantage, and operations are pushed day and night, week days and Sundays, without ever a moment's intermission, till the advent of the rainy season admonishes the miner that it is time to stop, take out his pumps, derricks and sluices, if he would not see them go down the river. Oftener, how-

ever, does it happen that the miner, being now in the midst of his harvest, disregards these warnings until it is too late, and sees his entire plant swept away and his pits filled up in a single night. Sometimes, too, a premature rain occurs, raising the stream suddenly, and the river-bed operator is, in like manner, doomed to see everything borne away on the flood before the working season is half over, and may be when it is hardly more than just begun. Owing to the occurrence of these and other mishaps, this is a somewhat precarious style of mining. Generally, however, it pays fairly, the amount of gold sometimes taken out from this class of claims being very large. Lately the business has been on the increase; and when the large tunnels now being built to divert the rivers from their beds shall have been completed, there is good reason to believe that enormous quantities of gold will be taken from the sections of river beds reclaimed.

If the hills in the vicinity of one of these river bed operations become much denuded of timber, as shown in our picture, this comes of the large quantities of lumber required for constructing the dam, flume, and other portions of the plant.

HYDRAULIC MINING.

IT IS OF CALIFORNIA ORIGIN.

Briefly described, hydraulic mining may be said to consist in the plan of breaking down and disintegrating the auriferous gravel as it stands in place, and carrying it into the gold saving apparatus prepared for receiving and washing it, by means of water discharged through iron pipes upon such gravel under great pressure. In drift mining, the gravel is reached and removed through shafts, inclines, or tunnels, and afterwards shoveled or piped into sluices and there washed in the same manner as that operated upon by the hydraulic process.



The business of searching after and securing gold by the drift method of mining, though not peculiar to California, nor yet wholly of modern origin, has, in this State, reached such proportions, and been prosecuted by means and appliances so varied, novel, and effective, that it may almost be said to have originated here.

As regards the hydraulic branch of the business, what constitutes its most noticeable features, the employment of water under pressure, the breaking up of the indurated

gravel with gunpowder or other explosives, and effecting its further disintegration by dropping it over precipitous falls—in short, all that is most characteristic about it is so new and wholly without precedent that it may be considered exclusively the product of California. Limited and imperfect at the start, this industry has developed into one of overshadowing magnitude, the mines worked by this process having turned out, before they were enjoined from running, more than a third of the annual gold product of the State.

Expanding, little by little, this hydraulic system has seemed more a growth than an invention, every year since its inception having witnessed such additions and changes as have sufficed to keep it constantly spreading and advancing. These gains, though sometimes small and seemingly unimportant, have been universal and continuous, consisting now in slight innovations upon previous methods, and again, in modifications of old or the introduction of new devices, or perhaps in improvements worked in the application of those already in use.

NEW DEPOSITS AND NEW MODES OF WORKING THEM.

The discovery of gold in California drew to this part of the Pacific Coast a numerous, eager, and energetic population. As the most of these newly arrived immigrants repaired at once to the mines and there engaged in the business of gold gathering, the more shallow and accessible placers were worked out with such rapidity that but for the timely discovery of more permanent deposits, and the employment of improved ways and means for working them, placer mining here would have undergone speedy curtailment and perhaps suffered early extinction. These later discoveries consisted of the auriferous gravel found in the inhumed beds of the pliocene rivers, and the vast accumulations of like material lying over and adjacent to these ancient channels.

THE DEAD RIVERS.

While drift mining is confined almost wholly to the beds of these ancient but long since obliterated streams, the superincumbent and outlying gravel banks constitute the principal sites of hydraulic operations.

The finding of these pliocene deposits was, like the original discovery of gold, the result of chance rather than of any preconceived theory or systematic plan of exploration. In the prosecution of their labors, the pioneer miners were early led to observe that the gulches and cañons entering the rivers immediately above the exceptionally rich bars, were apt to contain great quantities of gold dust. Following up and washing the gravel along such gulches and cañons, these miners encountered on either side thereof what appeared to be fertile streaks or "leads," to the breaking down and disintegration of which these depressions were evidently indebted for their special enrichment. These "leads," on being traced up, were found to run under the banks of the cañons, the courses of which, before their destruction, they had crossed at various angles. The further explorations of these strange formations not only showed them to be receptacles of great wealth, but disclosed the additional fact that they occupied deep, water-worn channels, once the beds of broad and swift-flowing streams. To these latter, so extinguished and entombed during the long ages of the past, the miners of the period gave the striking and appropriate name, "Dead Rivers," a term by which they have continued to be designated ever since.

EXTENT OF THE OLD RIVER SYSTEM AND ITS CONTEMPORANEOUS GRAVEL DEPOSITS.

These gravel deposits cover, in one shape or another, a considerable portion of the California gold fields. Only, however, in the more central mining counties, being those reaching from Tuolumne to Plumas, inclusive, are the "dead rivers" proper, and their associate gravel banks met

with. In Trinity, Humboldt, Siskiyou, and Del Norte counties, occupying the northwesterly angle of the State, extensive beds and deep-lying channels of gold-bearing detritus abound; but they lack the peculiar features that, if present, would warrant their being referred to the pliocene age. The most of them are clearly of recent origin, having been formed by the shiftings of the present streams and other agencies of comparatively modern date. Many of the hydraulic banks in this group of counties are due to land slides, which, coming down from the adjacent mountains and filling up the rivers, have diverted them from their former channels, in the great bends of which these masses now stand, peninsular in form, and with sides distinctly terraced. These terraces, or benches, denote the different planes on which these rivers formerly ran. Having been kept on a certain level for a long time, the stream formed along its banks broad alluvial flats, or bottoms. Through earthquake or other disturbance, opening a new channel for the river, or breaking away the barrier that had so long maintained it at this particular level, the bed of the stream was lowered for a considerable distance, leaving another of these high benches with its flat surface and sloping sides, as we now find them, the entire series, through a repetition of this process, having in course of time been produced.

Coursing along these benches are found distinct and well defined river channels, their descent corresponding with that of the present stream. While these channels are invariably rich, and are apt to have the gold pretty evenly distributed along them, there occur here none of those remarkable finds that distinguish the workings of the "dead rivers" proper, being those that pertain to the post-tertiary, or the early-quaternary era.

It has been suggested, and some plausible arguments have been adduced in support of the hypothesis, that the deeper of these deposits are of submarine origin, at least in part. The mass of them are however very clearly made up of fluvial and diluvial drift, as are also those found in Oregon,

as well, most likely, as in every other locality where hydraulic and drift mining have been practiced, outside of the central group of counties mentioned.

WHEN AND HOW THE DEAD RIVERS PERISHED.

Touching the age of these old time rivers, their sources and directions, the nature of their contents, the manner of their filling up and subsequent burial under lofty ridges and basaltic mesas, and, finally, their partial disinterment through the degradation of their inclosing mountain masses, geologists are pretty well agreed—that is, in so far as the main facts are concerned; volcanic outpourings and earthquake disturbances; diluvial drift; glacial, tidal, and fluvial action; ocean surfs and currents; uplifts of the earth's surface, clogging them with detritus through diminished grade; climatic changes, causing increased water flow; chemical decomposition; frost, heat, wind, and other meteorological agents, being by scientists universally recognized as among the more potent factors concerned in producing these phenomena.

That mutations so complicated and vast could not have been wrought within the limited period that has elapsed since the birth of our globe, as taught by the old theory of creation, must of course be conceded. But geological facts establish for the earth a much greater antiquity than that assigned it by this now exploded system of cosmogony. Science, turning over the leaves of the great "stony book" of nature, discovers for our world a long life and an eventful history—a history marked by commotion, revolution and change; these movements having been sometimes sudden and violent, upheaving mountains, disrupting the earth's crust, and destroying wide ranges of animal life; and sometimes slow and tranquil, sparing the most tender organisms, and little disturbing the then existing order of things.

Hardly yet has the popular thought awakened to the consciousness that geological time is not to be measured by

years or ages, but by such almost illimitable periods, that they seem, to our feeble comprehensions eternities of duration. Very inadequate, too, are our conceptions of the changes and transpositions that in times past have taken place on the exterior of our globe, which, as we see it now, has been, in good part, reconstructed from the ruins of pre-existing systems. Tall ranges of mountains were once the floors of the sea, and the inhabited continents of to-day were long ago submerged beneath the ocean, and there kept till the sedimentary deposits accumulating, raised their surfaces above the water; or they were lifted up bodily by the slowly operating forces that had before carried them down.

It was in the midst of convulsions and cataclysms like these when a long night of storm deluged the westerly side of the continent; when volcanoes lighted the crest and glaciers rooted out the sides of the Sierra; when the great basin of the Sacramento was rapidly filling in, and the foothills were being raised from the sea, that these deep-lying gravel banks were formed, and this system of "dead rivers" was blotted out and buried up.

Among the causes directly implicated in the production of these changes, floods, and volcanoes; the disrupting, comminuting, and transporting power of icebergs and glaciers; local uplifts, and subsidence of the earth's surface; ocean surfs and tides, and the erosive effect of running water, were the most widely prevailing and potent; many of these agencies having succeeded each other in regular order, and remained active throughout long periods of time. When we reflect that the ocean tides, at a time when the moon was much nearer the earth than at present, ran from six to eight hundred feet high, we find here a wearing and displacing force that must have eroded the rocks, against which it impinged, at a rapid rate and kept the loose material exposed to its fury in a state of fearful commotion. A single influx of such a tide would suffice to heap up great drifts of gravel, which the ebb might add to, or possibly carry away,

scattering it far and wide, to be still further dissipated, or perhaps again heaped up by the next incoming tide.

It was during the early tertiary, if not before, that the channels of these ancient rivers were mapped out and eroded. That their grades were then steep, may be inferred from the enormous size of many of the bowlders found along them, to say nothing of the much larger number that were probably carried further down and swept into the great depression now occupied by the Sacramento, San Joaquin, and Tulare plains, then a long extended sea-trough more than a thousand feet deep. These bowlders, composed of hard rock, show, by their rounded forms and polished surfaces, that they must have been moved by rapid currents, and traveled a long distance, a thing that would have been impossible had these pliocene rivers then run on their present low grades; or, supposing these immense masses of solid rock to have been worn into their present shapes previous to their being carried into these river channels, still the latter must have been much steeper than they are now, to have imparted enough force to the water to move such weighty masses for such long distances.

HOW THIS REDUCTION OF GRADE WAS EFFECTED.

After these old rivers had been so running for ages and ages over their swift descending beds, the country west of the Sierra Nevada, including its foothills, then covered by the great inland sea that reached west to the Coast Range, was slowly elevated, undergoing a total uplift of eight or nine hundred feet, reducing to that extent the fall in these rivers, and diminishing in like ratio the velocity of their currents. As a result their channels were eventually filled up to the top of the rim rock on either side, and often to a much greater height with the bowlders, gravel, sand, silt, and shingle, that before had been carried down and poured into the great receptacle that afforded for all these antediluvian streams an ample "dumping" ground.

A like choking up of these rivers would have ensued from a greatly lessened waterflow, but, in the absence of proof that this occurred as a contemporaneous event, we are bound to accept the theory here adduced as furnishing the true solution of this filling-in process, the evidences of its soundness being varied and conclusive.

OF WHAT THIS MATERIAL IS COMPOSED.

The bulk of this auriferous detritus, as we find it resting in the old river channels, or massed in the deep hydraulic banks, is made up, for the most part, of silicious sand, fine and coarse gravel, clay, formed from volcanic ashes or other sedimentary deposits, lava, tufa, conglomerates, fossilized wood, and boulders. The latter, as already remarked, occur, usually, near the bottom, and are often of great size, single stones weighing as much as fifteen or twenty tons being frequently met with. This detritus, in the form of secondary deposits, is found also gathered on the modern river bars and alluvial flats and basins, or spread out over the low prairies and rolling foot-hills, where both hydraulic and drift mining are sometimes prosecuted with good results, though not generally on a large scale. The rocky portion of this material is composed mostly of quartz, accompanied with fragments of every rock common to the Sierra Nevada, such as slate, serpentine, granite, etc., all more or less rounded and water-worn. There is also intermixed with it a small percentage of magnetic iron ore, in the shape of black sand. Fossils, both animal and vegetable, and at some points in great quantity, occur in the middle and upper strata of gravel. These organic remains consist of the bones and teeth of various animals, the trunks and branches of trees partially or wholly silicified, lignites and carbonized wood, in all of which latter the vegetable structure is clearly apparent. Cords of petrified wood have, in some places, been uncovered; also, Indian mortars and similar rude implements, proving the existence of man prior to the filling in of these pliocene rivers.

Sometimes the contents of these old river channels and hydraulic banks are composed of gravel from bottom to top; oftener, however, they consist of layers of gravel, sand, volcanic ash or clay, and lava, occurring usually from the bottom up, in the order here mentioned. Again we find this material interstratified without much regard to regularity, the lava, where any is present, constituting always the upper and the gravel the lower stratum. These bodies of sand, like the layers of volcanic ash, are sometimes flat but oftener lenticular in shape; both vary much in size, from a few feet to six or eight and occasionally as much as ten or twelve yards in thickness, their linear being always many times greater than their vertical extent. This sand, also a volcanic product, is sometimes so loose and dry that, if left unsupported, it crumbles under its own weight. Where it lies near the bottom or rim-rock, this arenaceous substance, being saturated with water, becomes a quicksand, causing much trouble when encountered in the excavating of shafts, inclines, or tunnels. Sometimes it is found hardened into a semi, and occasionally into a very compact sandstone, great masses of it in this condition resting under some of the table mountains. The volcanic ash occurs, superimposing the layers of sand or interstratifying the gravel, with which, however, it is never mixed up. Moistened with enough water to form it into a paste, it would appear to have flowed down the old river channels, until hardened, it was left in the places where we now find it.

Where not denuded, as large portions of them have been, the contents of these pliocene channels are covered with alluvial drift and volcanic flows, either in the shape of scoria, sand, and mud, or basaltic cappings, which latter take, usually, the form of mesas or table mountains, a structure that will be more fully noticed further on. These lava flows, which reach, sometimes, a thickness of more than a hundred feet, prove fatal to hydraulic washing wherever they occur in much volume, their hardness and thickness interposing an insuperable obstacle to their removal. The

detritus accumulated outside the old river beds, composed in part of volcanic and in part of true auriferous gravel, is apt to be free from lava coverings though often found deeply buried under masses of volcanic ash, and so impacted by chemical agents and pressure as to be almost as difficult of removal as the lava itself. It may be here observed that the term "lava" is, in popular usage, applied to much material that is not strictly such. For example, the heavy strata of volcanic sand and ash that occur in many parts of the mines, pass, locally, under the name of "white lava," while to another variety of this material, colored darkly by ferruginous stains, the name "black lava" has been given. Though their constituent parts are mostly of volcanic origin, these substances never have been in a molten state, but having been partially liquefied by water, were afterwards brought down and distributed by the same agency. While some of these pliocene channels, notably that of Tuolumne County, running nearly coincident with the Stanislaus River, were obviously filled up by a single flow of molten matter, this, in other cases, was accomplished only through successive and long continued eruptions. So, also, the accumulations of auriferous detritus would, in certain instances, appear to have resulted from one overwhelming movement, while in others they were effected by diverse and oft exerted agencies operating through a long series of years.

THE BLUE LEAD.

In the "dead rivers" proper, of California, the bottom stratum of gravel, besides being greatly impacted, is generally stained a deep blue color. Observing this peculiarity, and, further, that the gold here found seemed to be confined to a narrow streak, the discoverers of this class of deposits, named the first one met with "The Blue Lead," the word "lead,"—a corruption of the term "lode,"—having been applied by them to this stratum of gravel by reason of its supposed resemblance to an ore-bearing lode or vein. The

definite article "the," was prefixed as above, because this blue stratum, when discovered was thought to be the only formation of the kind in existence. Save in the matter of color, however, the name has proven to be a singularly unapt one, inasmuch as these formations, instead of being confined to a single one, have since proved to be very numerous in this State, the misnomer being still further emphasized by the fact that these deposits are not marked by any feature characteristic of a lode or vein whatever. In this latter sense, the deposit is virtually a nenentity, while every "dead river" in California may be said to have its "Blue Lead," that is, its bottom stratum of hard blue gravel, a color imparted to it by the underlying slate, and fixed by the chemical action of the ferric oxide escaping from the sulphurets of iron, always abundant in these bottom strata of gravel. On being exposed to the oxydizing effects of the air or to atmospheric water, this stuff loses its characteristic hue, taking on a reddish brown, or purple tint, or a blending of all these with perhaps some other colors. It then, also, undergoes rapid disintegration, or "slacks," as the miners term it, a process that converts it, when wet, into a soft mud, and when dry, into a sandy powder.

BIRTH OF PLIOCENE RIVERS—ORIGIN OF GOLD.

Eons ago, the westerly shore line of the continent lay east of the Sierra Nevada Mountains, the country to the west of that range, including nearly the whole of California and a small strip of Nevada, being then covered by the Pacific Ocean. While so submerged, the mud that afterwards formed the auriferous slates of the lower Sierra and its foothills, accumulated upon the ocean's bottom to a great depth. In process of time the region now occupied by the Sierra Nevada and its westerly lying foothills, began to emerge from the sea, but coming up so slowly that, for many years, it remained comparatively low and flat. During this period the pliocene rivers were born. Having their sources in

the far interior, they meandered slowly through the great champaign, forming islands, side channels, bayous, and lagoons on their long journey to the ocean. Then it was that the fluvial system, that at this day so puzzles the scientists and savants to decipher, was platted out, and the "dead rivers" entered upon their work of eroding their channels.

Traversing a region so broad and flat, these streams, pursuing their devious courses, doubled on themselves and ran for long stretches in every direction. The water-shed tributary to them was extensive, covering a portion of the Great Utah Basin, and most of the country now drained by our California rivers, and perhaps also, the southerly confluent of the Columbia. Gradually, as these countries continued to be forced up, the river grades became steeper and steeper, thereby accelerating their currents and augmenting their erosive powers. This increased swiftness, while it deepened, tended also to straighten the channels of these rivers, causing them to forsake portions of their former beds and seek their points of debouchment by more direct routes. This, with these ancient streams, was not only the wearing but also the transporting era, when along their deepened channels immense quantities of detritus and alluvions were swept into their estuaries, or carried on and emptied into the sea.

After the Sierra Nevada Mountains had been raised to a height much above their present summits, carrying up with them the superimposed slates and schists, this upward movement was arrested, and the work of their degradation began. Under the erosive effects of the atmosphere, water, frosts, and other elements, aided to some extent by earthquakes, icebergs, and glaciers, this work proceeded rapidly, inundating the country below to a depth of several thousand feet with the ruins of these mountains and their slaty covering. So vast was the quantity of this debris, that the "dead rivers," which now occupy sites far above the beds of the present streams, coursing, in some instances, along

the crests of lofty ridges, ran at that day in valleys several and perhaps many hundred feet deep.

But all this material was barren, no gold having as yet been eructed from its primary sources in the deep bowels of the earth. There was no need for it. No animal had yet been created having any use for a metal so pure and refined. The inhabitants of our globe throughout all the ages down to and far into the Cenozoic, got along well enough without it. The ichthyosaurus and the megatherium, the saurians that wallowed in the fens and the aquatic monsters that disported themselves in the ancient seas, were of a non-commercial, non-hoarding habit. But a notable event was about to happen in the progress of terrestrial things. MAN was soon to appear on the scene, and nature, anticipating the necessities and desires of this new animal, made provision for bringing up a portion of this auriferous stuff from the molten interior and placing it within his easy reach. To this end she managed, a little before his advent—geologically speaking—to inject into the slates and schists, already tilted up, numerous gold-bearing quartz veins, which, besides working a considerable change in these rocks, impregnated them more or less with the royal metal. The erosion of these slates, schists, and quartz veins, after they had been so impregnated with gold, having released this metal, it was carried down intermixed with the detrital mass, and distributed along the old river channels, and in the other localities where we now find it.

This effected, commenced the uplift before spoken of, and which, by diminishing the grade of these rivers, caused them to fill up with bowlders, sand and gravel,

THE VOLCANIC FLOWS,

Coming in a little later, and completing the destruction so begun. The line of this eruptive activity traversed the summit of the Sierra Nevada, along and near which innumerable burning peaks belched forth great quantities of

ashes, sand, cinders, and lava toward the close of the tertiary period. The evidence of these volcanic outbursts are met with along this mountain range for a distance of nearly five hundred miles. From Shasta on the north, to Tehachipi on the south, patches of lava, tabular and conical, capping the granite or resting in granitic basins, masses of basalt, dark and columnar, crater remains, beds of ashes, breccia and cinders everywhere abound. Having been energetic throughout a geological "day," these perturbations grew fainter and fainter, and at last subsided altogether. The earthquakes disturbed no more. The molten rivers, like their pliocene predecessors, ceased to flow, and the volcanos were extinguished. Then came

THE ICE PERIOD,

And the climate, from a torrid was changed to an arctic temperature. The tropical died out, and a boreal flora came in. Glaciers accumulated on the tops of the Sierra, rooting out those lacustrine basins, and furrowing the sides with deep cañons, into which the waters of the "dead rivers," long seeking escape through numerous small channels, were finally gathered, and commenced cutting the gutters of the present westward flowing streams—and the gelid season being long continued, accomplished a great work. The glaciers and the icebergs born of them, crushing the surface rocks into fragments, comminuted portions of them into sand, or ground them into mud, the water and the frost acting both chemically and mechanically, coming in to aid these disintegrating and triturating forces. The copious rains falling through an atmosphere heavily charged with carbonic acid absorbed that gas, and carrying it to the earth, tended much to promote the decomposition of every kind of rock, except only the purely silicious.

And so the masses of detritus before created were, during this stormy and frigid epoch, largely increased. Through the force of gravity and of running water, the finer and

lighter portions of this eroded material were brought down and distributed over the country below, and there left in the forms and under the conditions we now find it. The piles of drift that compose the ridges, or "divides," standing between the modern rivers that cut the westerly slopes of the Sierra, were derived from this source. To this period, too, must be referred all the placers lying above the levels of the ancient rivers, and in part, also, the shallow diggings of the lower foothills. The larger fragments of the disrupted rocks, and such other heavy material as these moving agents were unable to bring down, remained behind strewn over the lofty basins, heaped in moraines, or massed along the mountain sides where the dying glaciers had left them.

But at length "the morning and the evening" of this "day" also came to a close. The cold of the long dark Winter began to abate, causing a slow shifting of the isothermal lines. The sun's rays, struggling through the thick mists and the deadly vapors, gave birth to a higher plant growth and new types of animal life. The ice fields, diminishing, finally disappeared, and the rushing streams fed by them so long, waned and dried up. "The monsters of the great deep" retired to their element, the more gigantic and misshapen having suffered extinction. Birds and mammalia of more perfect form were created, and our earth, progressing through the centuries that make tertiary time, was fitted for the abode of man, who thereupon made his appearance, the physical features of California having, meantime, taken on something of the aspect for which they are now distinguished.

THE COURSES PURSUED BY THESE "DEAD RIVERS "

During their earlier history were, as before stated, extremely crooked; so much so, in fact, that their numerous and violent sinuosities, by creating the appearance of parallel channels in close proximity to each other, have led some observers into the mistake of unduly multiplying their probable

number. At many points along them, this feature becomes strikingly apparent. How devious must have been the course of the main south trunk along that portion of its route reaching from Gold Run to Quaker Hill is disclosed by the fact that it ran, or is supposed to have run, through all the leading mining camps between these two places. As its passage through these several localities would render the course of this great south artery a perfect plication, there is warrant perhaps for assuming that there occurred at this point a network of these ancient channels, a number of them having come in from various directions and centered here; this being more reasonable than to suppose that the main trunk pursued a course so exceedingly tortuous. This system of "Dead Rivers," taken as a whole, covers an area over a hundred miles long and from twenty to thirty miles wide. It consisted of two main branches, a north and a south, each having many confluent and, except coincidence of locality, corresponded very nearly with the river system which drains the same section of country at the present day.

In connection with the pliocene rivers of California there occur a number of those equally strange and unique formations, known as

TABLE MOUNTAINS,

Under which we find buried the best examples of a fully perfected and well preserved "dead river" extant. These "table mountains," the *mesas* of the Spaniards, which so stand over and mark the sites of the fossilized rivers, are, like these rivers themselves, a species of geological remains peculiar to California. These remarkable elevations are composed, for the most part, of lava flows which, issuing from the volcanoes along the crest of the Sierra and running down the already partially filled channels of the ancient rivers, covered their contents with a molten mass, which, on cooling, left them capped with a heavy stratum of basaltic rock. These remains are not now numerous or extensive; the table mountains that once stood over many of the

pliocene channels having suffered destruction and disappeared altogether, or left only faint traces of their ruins behind. What were once tall and far-reaching structures, exist now as only isolated sections or low rocky mounds, their relics gathered in long half buried ridges, or scattered widely over the adjacent plains. Even the best preserved of these lava built *mesas* extend now for only a few miles unbroken. Where not wholly demolished, they have been at many points intersected and large portions of them carried away by the modern rivers, leaving them so disjointed and fragmentary that, looking across the deep chasms that divide what is left of them, it is hard to believe these far separated mountain wrecks formed once a complete and continuous plateau.

But, though disrupted and so nearly destroyed, these fragments remain the silent witnesses of the fiery floods and physical commotions that marked the close of the pliocene epoch, the enduring monuments of the mysterious past, the fit mausoleums of the "dead rivers." Lifting their fortress-like forms far above the surrounding country, they must forever stand a geological sphinx, exciting alike the wonder of the thoughtful scientist and the careless observer.

Viewed from a distance, these "table mountains" have the appearance of long, wall-shaped ridges, bald and so nearly level on top that their inclinations are imperceptible to the eye. A talus of the broken rock fallen from above has almost everywhere formed along their bases, reaching up two-thirds of the way or more to the top, their sides above this talus being perpendicular and often impending. Their upper surfaces, almost wholly bare and timberless, are strewn, sometimes quite thickly, with large, black and scraggy boulders, slightly rounded, and mostly of uniform size and shape. These boulders are of volcanic origin; are, in fact, nothing but loose and disjointed masses of basalt, indicating by their rough exteriors that they have "weathered" into their present shapes where they lie. The supposition that they could ever have been subjected to the

action of running water, or even to much attrition upon each other, is precluded by the position in which we find them. Being nearly destitute of soil, little is ever found growing on the tops of these *mesas*, except perhaps a few shrubs or stunted pines.

The most extensive and notable of these plateau remains are those known as the Stanislaus and the Concow, or Cherokee, Table Mountains, the former situate along the Stanislaus River, mostly in Tuolumne, but partly in Calaveras County, and the latter at Cherokee, in Butte County, and both of which, protected by the unusual thickness and the excessive hardness of their basaltic coverings, have escaped to a remarkable extent the disintegrating and eroding effects of the elements that have so devastated these structures elsewhere in the State.

The following description of the Stanislaus *mesa*, much the more shapely and well preserved of the two, will serve to convey some idea of this class of formations generally. Commencing in the southern part of Calaveras County, this lava flow, after following for several miles in a west south-westerly course along or near the stream whose name it bears, crosses the same into Tuolumne County. After entering this county it runs, holding nearly the same course as before, for a distance of eight or nine miles, when it is again intersected, and a mile or more of it carried away by the Stanislaus River. Reappearing on the opposite bank of this stream, it pursues its course five miles southwest, where its continuity suffers another interruption, a mile and a half of it having been here broken down and swept off by the waters of Black Creek. Beyond this chasm it comes in again, precipitous and strong, holding, without further break, to its final terminus seven miles below; the entire *mesa*, gaps included, being about thirty-five miles long. On the southeasterly side of the Stanislaus, opposite the reach that terminates at Black Creek, stands a heavy body of table land, evidently a part of the original mass, which, here spreading out into what might have been a sort of lacustrine expansion, has

been intersected by the river, leaving a portion of it standing on either side.

On top, this table mountain varies from sixteen to eighteen hundred feet in width, its summit being nearly two thousand feet above the Stanislaus River, and five hundred feet above the common level of the country adjacent, the general surface of which has, since these table mountains were formed, been lowered to the extent of three thousand feet or more. Through this process of degradation, the entire topography of the country has been reversed. The "dead rivers," now inured high above the beds of the living streams, ran, during pliocene times, in deep depressions, while the bottoms of the valleys of that period are now on the tops of lofty ridges, some of them being nearly two thousand feet above the present rivers.

In general terms, these *mesa* piles may be said to be composed of the following material, viz: A top stratum of basalt, from fifty to one hundred and forty feet thick, very hard, dark colored, and, in places, distinctly columnar; underlying this is forty or fifty feet of pipe clay and sand. Next comes in a layer of coarse gravel, usually from ten to twenty feet in thickness, and under this the pay streak, which consists, usually, of some four to six feet of finer gravel lying on the bedrock. These strata, while they vary in thickness with different localities, usually occur in the above order; the pipe clay and sand, a sedimentary deposit stratified in beds, sometimes horizontal but oftener lenticular, run frequently into a fine sandstone, which crumbles readily on being exposed to the air. The absence of any perceptible partings in the volcanic capping of the Stanislaus deposit, would denote that, thick as it is, it had all been poured out at a single flow. The pliocene river buried under this basaltic mass having been partially disinterred by the pick of the miner, has shown itself to be, everywhere, more or less auriferous, as has been the case, also, with such other of these ancient channels as have in like manner been reached and explored. Where covered by table mountains, these channels have to be opened up and

their contents removed by the drift method of mining; only, as at Cherokee Flat and Morris Ravine, where the superimposed basalt has been broken down and removed, can they be worked by the hydraulic process.

Having thus briefly described the origin, extent, and general character of the deposits to be handled by the hydraulic and drift methods of mining, we come now to consider the ways and means employed for utilizing the same; and first of

HYDRAULIC MINING—EARLY HISTORY AND PROGRESS OF THE BUSINESS.

Where, in California, hydraulic mining originated, or who was its inventor, if invention it can be called, is at this day a matter of uncertainty, two parties and two places laying claim to this distinction. One of these parties, whose name is unknown, is said to have employed water under pressure for washing gravel on a ravine claim at Yankee Jim's, Placer County, as early as the Spring of 1852. The apparatus here used was crude and of limited capacity. The water, taken from a small ditch running along the hillside near by, was carried in a flume and emptied into a barrel, set on a frame about forty feet high, whence, escaping, it was conducted through a rawhide hose six inches in diameter and discharged upon the gravel to be washed. To this hose was fitted a four-foot tin tube, ending in an inch nozzle. Supposing this statement to be well founded, we have in the above feeble effort and sorry appointments, the origin of hydraulic mining as at present conducted in California. In the application of water to gravel washing through such crude contrivances, we detect the life germ, or, as the Darwinian philosopher might phrase it, the protoplasmic idea of the business.

About the same time, a miner named Chabot, working some ground at Buckeye Hill, near Nevada City, contrived a plan for bringing water upon the same through a sort of penstock, being a set of inclined wooden boxes, so strength-

ened by iron clamps that they were enabled to withstand a pressure of fifty or sixty feet. To the lower end of these boxes was attached a four-inch canvas hose, through which the water was conveyed to and discharged upon the gravel to be washed. Although there was no nozzle affixed to this hose, the water under the above head, and so compressed, escaped from it with such force as to greatly facilitate washing operations.

In the month of April, 1853, E. E. Matteson, a member of a small company mining in the same vicinity, rigged a hose much after the style of that already in use at Yankee Jim's, but, as it is asserted, without any knowledge that a similar machine had before been invented, if, indeed, such were really the case. As it is however possible that both of these parties and places may justly lay claim to the paternity of this process, as above set forth, we shall, in the absence of authoritative data on that point, assume that it was really so.

Perceiving the benefits likely to arise out of this novel application of water in gravel washing, the miners failed not to avail themselves of it wherever the conditions would admit of their doing so. The alacrity with which these men hastened to adopt the new method was, in fact, such as seemed to argue on their part not only a ready perception of its present advantages, but also an early consciousness of its vast possibilities. Received so favorably at the outset, operations by the hydraulic process, or "hydraulicizing," as it was called, were speedily extended throughout all the more central mining counties. So rapid indeed was the growth of the business, that it came in the course of a few years to be overdone to such an extent that a reaction, followed by a long season of depression, ensued. This reaction did not, however, result from over-confidence in the new mode of procedure, but from other and extrinsic causes. The miners, not then aware that the gravel below a certain, and in most cases a very inconsiderable depth, would become so hard as to require powder to shatter and large quantities

of water to disintegrate and run it off, commenced operations on areas so small that the stock of material available with their imperfect outfit and limited supply of water was soon disposed of. This point reached, they were forced to suspend operations, their claims being too small to warrant the expenditure necessary for putting them in proper shape and bringing on the requisite amount of water, even if the owners had possessed the means for making these improvements, which generally they did not.

And so after a considerable impetus had been given to hydraulic mining in a small way, this industry, after it had been tolerably prosperous for five or six years, suffered a relapse, and this, notwithstanding many valuable improvements had meantime been introduced. Throughout the decade that followed 1857, this, in common with most other branches of mining in California, was much neglected, owing to the heavy tide of emigration that had in the interim set towards British Columbia, Washoe, Idaho, and other, for the time being, more attractive countries. During this period hydraulic mining, but for the efforts of a few large companies, would have remained in a comparatively rudimentary state, production restricted and active operations so depressed as to amount to an actual retrogression of the business. After an experience so discouraging, small companies and individual claim-holders being willing, as a general thing, to dispose of their interests on easier terms and at more moderate figures, these properties were largely bought up by parties of more ample means, who then aggregated them into estates of sufficient size to justify their being thoroughly opened up, well equipped and abundantly supplied with water. With this change a new and better era came in for the business. Small enterprises gave place to larger ones. Companies who confined their labors to running off the loose top gravel diminished, while those capable of successfully handling the hard bottom strata, increased in numbers. Money in larger sums began to be invested, improvements of every kind assuming, at the same

time, grander proportions. Ditches and reservoirs of increased capacity were constructed, other portions of the mining plant having been, in like manner, enlarged and perfected. The green rawhide hose, subject to early decay and ever liable to burst, was soon displaced by stout cotton canvas, a material not only more lasting, but capable of sustaining a greater pressure; this canvas, in turn, giving way to iron pipes, still stronger and more enduring. The tin tube disappeared and cast iron cylinders, with detached nozzles came into use. The miniature gold saving apparatus first employed was superseded by long, well riffled sluices, supplemented by undercurrents, secondaries, and similar adjuncts. Instead of being confined to thirty or forty feet, as at first, water came to be used under a pressure of two or three hundred feet. Bedrock tunnels were projected and commenced for drainage and working purposes, cement mills were put up for crushing the hardened gravel, and an infinitude of auxiliaries, great and small, were pressed into the service of the hydraulic miner.

But with all this improvement and progress, this industry was not without its difficulties and drawbacks. With the season of its decadence over, the obstacles incident to the business did not cease. On the contrary, they seemed to increase as operations were extended, old troubles becoming aggravated and new ones presenting themselves. Large improvements called for large expenditures, and novel agencies presented novel obstructions; forces powerful enough to overcome one set of impediments failing not to beget new ones. The washing down of immense quantities of gravel tended to diminish the grade and fill up the outletting channels. If a much greater amount of water was to be brought in, ditches skirting precipitous cliffs and spanning deep gorges had to be extended far into the mountains, where frost and snow, land-slides, avalanches and other hindrances, before unheard of, had to be encountered. Any increment in the volume of water used in washing, through its increased tendency to carry off the finer particles of metal, necessitated

the making of corresponding additions to the gold-saving appliances. The opening up of the gravel beds in depth, compelled the employment of gunpowder and other explosives for breaking up the indurated material, and also of expensive and powerful derricks for handling the bowlders; and so of other costly requirements, which, keeping even pace with the general advancement of this industry, have rendered it one of extreme difficulty and not always free from pecuniary hazard. Nor have these untoward conditions been confined to the medieval age of the business. They attend it still; they form an integral and inseparable part of it. As they vexed his predecessor, so have they in turn continued to vex the hydraulic miner of the present day, who seems likely to transmit the exigencies of the situation, little abated, possibly intensified, to his successors in interest.

TERMS AND PHRASES USED IN CONNECTION WITH HYDRAULIC MINING—THE USE AND MEASUREMENT OF WATER, ETC.

Preliminary to what is to be said concerning the ditches, reservoirs, and other structures used for collecting, storing, and transmitting water, it may be well to define certain terms and phrases which will be found of frequent occurrence in the description about to be given of this class of improvements and the varying standards of measurement adopted in buying and selling water, some of these terms being original with the California miners, while nearly all have a peculiar or local signification.

By the term "grade," as used in mining affairs, is meant the amount of fall given to a ditch, flume, sluice, etc., or that occurs in running water. The sluice grade is determined by two different methods of measurement, the one being the fall that occurs in a linear distance of twelve feet—the length of an ordinary sluice box—and the other by the percentage of fall; the latter being the most intelligible, and the method now most in use.

"Tailings" consist of the gravel that has been once washed and thereby deprived of all the coarse and most of the fine gold it originally contained; this waste stuff being also called debris, detritus, slums, and sometimes by the absurd name of *slickens*.

"Dump" signifies the amount of fall had at, or immediately below, the outlet to the mine, and which according to its extent, affords greater or less facilities for dropping the tailings down, or running them off out of the way; insufficient "dump" proving, sometimes, a fatal trouble with otherwise good mines.

A "run" denotes the length of time gravel washing is continued without stopping to "clean up"—that is, collect the gold caught in the sluices, undercurrents, and other apparatus provided for the purpose. In length the "run" varies with circumstances, extending through one, two, or three months, and, occasionally, throughout the entire season.

The term, "a miner's inch of water," is of California origin, having grown out of the method of measurement here adopted by the ditch companies in disposing of water to their customers.

"A miner's inch of water" varies with different localities to such an extent that it may almost be said to constitute an arbitrary quantity. This arose from the practice that obtained in the early days, whereby each ditch company having water to sell, fixed the quantity to be represented according to such standard as best suited themselves, and which, coming to be generally recognized, grew at last into a custom having the force of law in that locality. Hence the disparity in this respect that prevails throughout the mining districts of the State. In the delivery of water, the varying elements consist of the head, or pressure, and the size of the aperture. The "miner's inch" that has come to be most widely accepted is the quantity of water that will flow from an orifice one inch square through a two inch plank, with still water standing to a depth of six inches above the top of the orifice. Through a plank so perforated, 2,274 cubic

feet of water will escape in 24 hours—nearly 17,000 gallons. Where this method of measurement is adopted, a long horizontal slit, one inch high, is made in the discharge box, a slide being used to regulate the number of inches which it is intended shall escape. This being a simple and convenient arrangement for determining the quantity of water delivered, accounts, in part, for its popularity.

Efforts have been made from time to time in the State Legislature to have the quantity of water contained in a "miner's inch" fixed by law, one or more bills having been introduced in that body with a view to effecting this object. One of these bills provided that such inch should consist of the amount of water that will pass through an orifice one inch square through a plank one inch in thickness, and under a pressure of seven inches, measured from the centre of the orifice. For one reason or another these bills failed of enactment, chiefly because it was thought best to leave the quantity of water, like the price, to be regulated by the miners and ditch companies themselves, as neither of these parties had shown any great desire for a change. Nevertheless, there are good reasons why this quantity of water should be fixed by statute, thus rendering it uniform and certain, whereas there are none whatever why it should be suffered to remain vague and indeterminate, causing often much hardship to the consumer of water, and also sometimes serious inconvenience where the term requires to be legally defined. In mechanics, "an inch of water" has a settled and definite meaning, and so also should it be in mining usages.

By the term "head of water," is meant the quantity sold by the ditch owner to any one mining company, or the quantity used by the latter from whatever source obtained. In hydraulic operations, "a head" varies from two or three hundred up to as many thousand inches of water. Few companies buy as much as four thousand inches, though some there are, who, owning it themselves, consume even a greater quantity, running it through their own ditches.

Hardly any companies run a "full head" the year round, the most of them abating the quantity largely as the dry season advancing diminishes the supply.

In selling the water, the inch, or "head," is reckoned for the length of time the water is used, which may be for twenty-four hours, or for ten, twelve, or such other number as may be agreed upon. The price of water for a ten hour run varies from six or eight to twenty cents per inch, thirty to sixty per cent. additional being charged for twenty-four hours. Some little abatement is generally made in favor of large and steady consumers. To those who take but little water and at irregular periods, as in the case of drift miners, the above rates are apt to be advanced. Before so many of the hydraulic mines were enjoined, there were probably as many as a million and a half ten-hour inches of water sold throughout the State in the course of a year.

DITCH LOCATION AND CONSTRUCTION.

As water has been the principal agent engaged in releasing the gold from its original matrix, and transporting it to the *placers* or places where we now find it, so has this element in the hands of man been forced to undo a portion of its work, and help separate the precious metal from the worthless material with which it had before so helped to mix it up. Being so indispensable, then, for the successful prosecution of this branch of mining, the first thing to be done, where a hydraulic enterprise is contemplated, is to make provision for an ample supply of water, it being presumed that the auriferous character of the gravel to be worked has been proven, and the sufficiency of the outlet or dump established beforehand. If a company have already introduced water into the neighborhood, and have it for sale, this supply may be obtained from them. If not, then a ditch of suitable dimensions must be constructed for taking water from the most available source at command, and conveying it to points where required for use. To obtain,

in the central mining counties of California, anything like a large and really serviceable water supply, unless it be purchased of parties holding under a previously established franchise, is not, at this day, an easy matter. All the water within easy reach has, in fact, been appropriated to an extent that leaves no surplus after the supplying streams have met existing requirements upon them, unless it be during the three or four months that such streams are kept replenished by the winter rains or the melting of the snow on the mountains, the former occurring at a period of the year least favorable for hydraulic operations. By reason of the extent to which the water has been so appropriated, hydraulic mining in this section of the State may be said to have very nearly reached its limit of greatest practicable expansion. Only through the construction of additional reservoirs for its storage can the stock of water be here much augmented. Under these circumstances, any large increase in the quantity of tailings likely to be hereafter discharged from the mines through an extension of hydraulic operations, need not be apprehended. In the northwesterly group of mining counties, there is still much summer water running to waste. This water, though generally claimed, has not been diverted from its original channels, and can be secured at little cost. These counties afford, therefore, a better field for ditch building than now offers in the centrally situated counties further south.

Aqueducts, of one kind and another, have from the first, constituted an important auxiliary to the mining industries of California, commencing to build them on a small scale, having been almost coeval with the gold epoch itself. As early as 1850, small ditches were dug for bringing on a "tom" head of water, their size having been increased soon after, when the sluice came into use. Though short and of limited capacity at the start, these improvements have so increased in magnitude and number, as well as in the engineering skill displayed in their construction, that some of them, with their supplying reservoirs, fairly rival many

works renowned for their boldness of design and national in their objects and character. The most of the earlier enterprises essayed in this line proved financially fortunate, the ditches dug being short and comparatively inexpensive, while water met with ready sale at high prices. This encouraged to the undertaking of too many works of the kind, entailing loss where profit was expected. The much tilted slates that strike broadly across the mining regions, being unfavorable for the retention of water, there occur within that belt, few streams capable of filling a large sized ditch. To secure more full and permanent supplies, the water had to be taken from the main rivers, which necessitated the building of much longer ditches than were required when it was obtained from local sources. Many of these longer and more extensive ditches were built at a time when both labor and water rates remained at high figures, though both, through the rapid exhaustion of the surface placers, had greatly depreciated before these works were completed, whence it happened that the latter, though built at great cost, yielded only diminished revenues when they came into use.

All through the period that hydraulic mining remained especially depressed, being the second or middle stage of the business, ditch properties made such poor returns that the owners sometimes allowed them to be sold to satisfy judgment creditors, or abandoned them altogether, some very costly works having suffered the latter fate. What worked much disaster to these early ditch owners, was the mistakes into which, through inexperience, they often fell, either in locating or building their canals; the erection of lofty and expensive flumes, to be soon blown, burned, or rotted down, well illustrating this latter class of blunders. For these costly and short-lived structures earth excavations or iron pipes are now generally substituted.

In the preparation of the following remarks on ditch, dam, and flume construction, the able and authoritative article on these several topics prepared by Charles Wal-

deyer, and published in the report of the Commissioner of Mining Statistics, has been freely drawn upon. Some use has also been made of the essay on Hydraulic Mining, by Aug. J. Bowie, Jr., a paper replete with useful information on the subject treated of, and which has met with general commendation on the part of hydrostatic engineers and practical miners.

In locating the route of a projected ditch, and selecting the source of its water supply, both should be maintained at as high a level below the deep snow line as possible; another point to be held in view being the securing of an ample summer stock of water, including facilities for its storage. If kept at a high elevation, the ditch will command a larger scope of mining territory, besides being able to deliver the water under increased pressure, a condition on which its effective power is largely dependent. The ditch, if too low, loses these advantages; if too high, it is liable to suffer obstruction from snow and ice, delaying the season of active operations, and necessitating considerable expense for freeing it from these impediments. With a given amount of water, more and better work can be done in warm than in cold weather. Among secondary objects to be kept in view during the preliminary stages of these enterprises, is the securing, by location or purchase, of all streams along the main trunk that can be readily made tributary thereto. By attending to this, any waste occurring through evaporation, absorption, or leakage, may be made good, and the water flow thus be kept to the full carrying capacity of the ditch; which latter, where such addition to the water is feasible, may, sometimes to great advantage, be enlarged along its lower portions, where the difficulties of construction are apt to be less than they are higher up. These subsidiary streams may also be serviceable in helping to replenish the main ditch when its principal sources of supply begin to fail, as they usually do with the advance of the dry season. Where it is not desirable to empty the water of these side streams into the main ditch, it is to be

carried over or under the latter, as found most convenient. Because of the rapidity with which evaporation goes on in the warm and arid climate of California, deep and narrow ditches, other conditions being equal, are preferable to broad and shallow ones. Where, however, the former involve the necessity of much extra bedrock cutting, economic considerations require that they should give place to shallow ditches made wider.

FLUMES, TUNNELS, GRADES, ETC.

In the construction of these artificial aqueducts, it almost always becomes necessary to transmit the water, for a portion of the way, through tunnels, iron pipes or flumes, recourse to the latter being had where a deep ravine or other depression is encountered, affording no facilities for carrying a ditch around the head of such depression, or where to do so would unduly increase its length; and, again, where the water has to be conveyed, at a considerable elevation, through a gorge having steep rocky sides, with too little earth to hold a ditch. In the former case, recourse to fluming is much less frequent now than aforesaid, depressed iron pipes having been largely substituted for these wooden structures, which, besides their great cost, have proved to be exceedingly ephemeral and insecure. Their average life has not exceeded eight or ten years, in consequence of their liability to destruction by wind, fire, and early decay, those put up at greater altitudes being, moreover, exposed to be swept away by avalanches, or crushed under the weight of the snow.

In the early history of ditch building, some of the flumes erected were very lofty, reaching often a height of one hundred and fifty, and occasionally, as much as two hundred feet or more; one put up at Big Oak Flat, in Tuolumne County, having attained the extreme height of two hundred and fifty-six feet. Though very simple structures, not involving any great amount of mechanical skill, some bold

feats of engineering were displayed in the building of these flumes. This was especially the case where they required, as sometimes happened, to be fastened high up against the sides of precipitous cliffs, the workmen performing their labors on scaffolds suspended from above.

Of this method of hanging flumes from the sides of steep cañons, there is presented, on the line of the Miocene Company's ditch, Butte County, a notable example. This ditch, which traverses, for the most part, an exceedingly rugged country, reaches on its route a locality where the superintendent of construction, Wm. H. Bellows, had left him only the choice of erecting a trestlework nearly two hundred feet high, for supporting the flume, or adopting the plan of resting it on brackets, attached to the side of a vertical cliff three hundred and fifty feet high. Having made choice of the latter alternative, workmen were slung in ropes over the edge of the precipice and dropped down, more than two hundred feet, to the level of the projected flume, where they drilled two lines of holes in the basaltic wall, the one for the reception of the brackets and the other of their supporting braces or suspenders. The brackets here used are made of T rails, bent into suitable shape, ten feet projecting horizontally from the face of the wall, for the flume to rest on, and two feet at the ends, rounded off for the purpose, entering and being firmly fastened in the lower line of holes made for their reception. The other end of the bracket, which terminates in an eye, is bent at right angles, and passing upward outside the flume, holds it in place. Into this eye the lower end of the supporting brace, made of heavy round iron, is fastened, the other end entering one of the holes in the upper line, into which it is secured by clamps and soldering. The brackets are eight feet apart, each one being capable of supporting fourteen and a half tons' weight. The flume, which is four feet wide and three feet deep, has capacity to carry three thousand miner's inches of water. Before reaching this bracketed section it is supported on a long string of trestlework eighty

feet high. Elsewhere on the line of this ditch are two similar structures, one, one hundred and thirty-six feet high, and the other one thousand and eighty-eight feet long and eighty feet high. The bracketed portion of the flume is four hundred and eighty-six feet long and one hundred and eighteen feet above the foot of the cliff.

The box or body of the flume is usually made of one and one-half inch boards, good lumber, sugar pine, where it can readily be procured, being used for the purpose. The supporting frame work may be, and generally is, made of coarser stuff, such as ordinary pine, spruce, fir, and the like, its size and strength being proportioned to the duty required of it. The sills or sleepers on which the sustaining posts are set, should be charred, as a protective against decay; and all high flumes ought to be anchored with strong wire or wire rope, to hold them firmly against the wind. The building of flumes, wherever practicable, should be dispensed with, both on account of their original cost and the current expense of keeping them in repair. While this style of conduit costs in the first instance from forty to sixty per cent. more than a ditch, the outlay upon it, so long as it lasts, is in about the same proportion, the annual expenditure on this account amounting to at least ten per cent. of the original cost. The ditch, when finished, is all the while growing better, and, if properly located and well built at first, requires thereafter but little renewal, and never entire reconstruction, being, in this respect, the reverse of a flume.

As sheet iron flumes would manifestly possess many advantages over those built of wood, it may reasonably be expected, now that the price of this material has been so much reduced, that it will yet come to be largely employed for such purpose. Iron, protected by coal tar or other substance against oxidation, besides being more durable, would on account of its smoother surface, offer less obstruction to the passage of water than sawed lumber.

The fall given to the California mining ditches ranges from six to twenty-five feet per mile. These are the ex-

tremes, the average being about thirteen feet—three-eighths of an inch to the rod—which experience has shown to be about the proper grade, as this insures a tolerably large delivering capacity without imparting to the current a velocity calculated to rapidly wash the banks. The tendency of late years has been towards the adoption of steeper grades, the firm earth of the mountains resisting erosion, while the deep narrow ditches are more easily kept clear of snow and ice than wide ones.

Even after their completion, more or less trouble is for a time experienced with all ditches, through land slides, breakage, sipage, etc. In the course of a year or two, however, if well built, their banks become so solidified and their sides and bottoms so covered with sediment that they lose little by leakage and are easily kept in repair, unless they be of extra large size, or the ground is unusually loose and porous.

While it is proper in the construction of aqueducts of this kind to commence work simultaneously along the entire line, it often becomes expedient to finish the upper part first, to the end that, the water being let in, it can be used to float down the lumber required at points below. Usually the best timber is found along the upper portions of the ditch and much is gained by cutting it there and floating it down in the manner mentioned, instead of transporting it by teams, which becomes expensive, especially if the hauling has to be done over rough ground and ascending grades.

In running the lines of a ditch, projecting points and ridges are sometimes encountered which require to be pierced with tunnels as a means shortening the route or securing a passage on a proper level. Generally these adits are short, though in a few instances they reach a length of a thousand and even two thousand feet or more.

THE DAMS, WASTE GATES, AND SNOW GUARDS

Pertaining to these aqueducts and essential to their protection and efficiency need not here be described with much

particularity, their forms and uses being generally well understood. The dams connected with these mining ditches do not differ from similar structures elsewhere, save in that they require to be built especially strong to secure them against the extreme high water that annually occurs in the mountain streams of California. Owing to the great abundance of fine timber found near their sites, they are built, for the most part, of lumber, advantage being taken of the low stage of water that always prevails toward the end of the dry season to put them in. The waste gates, placed at proper intervals along the ditch, allow the water, after reaching a certain level, to escape, thereby protecting the banks from undue pressure, as well as preventing the water raising so high as to overflow and wash them away. The "snow-guard," so-called, consists of a low shed or covering, composed of strong timbers placed over the ditch where it runs along the side of a steep declivity, for the purpose of protecting it against the snow, which, at these points, crowding down steadily or sliding in suddenly from above, is apt to cover the ditch up to a great depth, or carry it away altogether. Even the iron pipes laid down for conducting the water along these places have sometimes to be in like manner shielded, or they would be crushed flat by the weight of the snow.

DEPRESSED IRON PIPES.

This style of conduit is employed to convey water, not only over shallow depressions, superseding, when so used, the elevated flumes, but also for transmitting it across ravines and gorges too wide and deep to be spanned by a flume, and around the heads of which a ditch cannot well be carried. Of such use of iron pipes, in connection with ditch enterprises, we have several noted examples in California, the most extensive and costly work of the kind in the State being that of the Spring Valley Canal and Mining Company, at Cherokee, Butte County. The pipe here laid

down carries the water of the company's ditch across the West Branch, a tributary of the North Fork of Feather River, and has capacity to discharge fifty-two cubic feet of water per second. It is fourteen thousand feet long, has an approximate interior diameter of thirty inches, and, at its lowest point, is subjected to a pressure of eight hundred and eighty-seven feet. The heaviest material used in its construction is three-eighths inch boiler iron, English plate. Though in use for nearly eight years, this pipe is still in good condition, showing, in fact, little visible impairment by time. At a point further up, the water of the same ditch is conducted across Little Butte Creek in a similar pipe, depressed one hundred and forty-eight feet, and nearly one thousand feet long. At several other places in the State, these inverted siphons have been put down, and always with satisfactory results. In some instances, where these deep gorges are to be crossed, the iron pipes have been suspended from wire cables instead of being laid on the sides and bottoms of the cañons; but this, where the pipe is of very large dimensions, would hardly be practicable.

NUMBER, LENGTH, AND SIZE OF MINING DITCHES IN CALIFORNIA.

All told, the number of mining ditches in this State amounts to several hundred. Many of them, however, are small, carrying only from fifty to three hundred inches of water. Those on which the hydraulic diggings are mainly dependent, are capable of carrying all the way from four or five hundred up to four thousand, and even as much as six or seven thousand miner's inches of water. The main trunk of the South Yuba Canal, extending from the head dam on the South Fork of Yuba River, down to Bear River, a distance of one and one-half miles, transmits, for that distance, the unusually large quantity of seven thousand inches of water. This part of the company's canal is six feet wide on top, five feet deep, and has a fall of thirteen feet to the

mile, giving it the largest carrying capacity of any ditch in the State. The Chalk Bluff branch of this ditch, when full, conveys over four thousand inches. During the greater part of the year, this company runs to the various mines supplied by their system of ditches over two hundred million gallons of water daily.

The aggregate length of all the mining ditches in the State will reach very nearly, or quite, five thousand miles, besides something like one thousand miles of subsidiary branches, not to mention the many small distributors required for taking the water from the larger ditches or reservoirs, and carrying it to the various points on the mining claims where it is needed for use. As regards length, these ditches vary greatly, some of them being not over three or four miles long, while others reach a length of forty or fifty, and, in a few cases, even as much as seventy or eighty miles. As a general rule, the longest ditches are found in the more central mining counties, extending from Mariposa to Plumas.

COST OF DITCH BUILDING.

The cost of these structures varies, of course, with their size, length, and the natural obstacles and other hindrances encountered in building them. It is the case, however, that large ditches cost more, proportionally, than small ones, the money expended upon the former ranging from four or five up to fifteen, and occasionally as much as twenty thousand dollars per mile—cost of dams, flumes, and iron pipes, where the latter have been used, being included in the estimate. In some parts of the State, medium sized ditches have been built for two thousand dollars per mile, and even less. This disparity in the cost of these works is due to the difficulties to be overcome in constructing them, and which, in some cases, are very formidable. To such obstacles as are apparent and can be counted upon in advance, there is to be superadded that element of uncertainty

arising from an indeterminate amount of rock excavation, the full extent of which can be definitely ascertained only as the work progresses. A slippery underlying bedrock, causing the ground from above to slide down into the ditch; a springy soil, rendering it difficult to make the ditch-bed solid and keep it in place, are also to be enumerated among the troubles that cannot well be foreseen and guarded against at the start.

The entire cost of all the mining ditches heretofore constructed in California approximates, and may even exceed, thirty million dollars, not including those now disused or abandoned, of which there are a good many, some of them built at great cost.

How losses were incurred by the pioneer ditch builders in this State, through neglect of what would now be considered the most necessary precaution, is well exemplified in the case of the Truckee Ditch, constructed over twenty years ago by English capital, and which, after nearly a million dollars had been expended upon it, was finally abandoned, the investment, excepting a trifle afterwards realized from the sale of the company's water franchise, having proved an entire loss. This ditch was dug to bring water into Minnesota, Alleghany, and other camps on the divide between the Middle and the North Forks of the Yuba. Although it had capacity for carrying three thousand inches of water, it was, for its size, a costly concern. Along it were more than thirteen miles of flume, the most of it suspended from the rocky sides of a steep cañon. A capacious and expensive reservoir was built at its head, under the impression that the water requirements of the district to be supplied by it would be large and lasting, an expectation in which the company was disappointed, for, while the drift diggings and shallow placers had proved rich, there were no extensive hydraulic deposits in the district, hence but little demand for water; a neglect to determine this point in advance having been the fatal mistake that wrecked the enterprise. Many other failures as absolute as this, though not always

so pecuniarily disastrous, occurred during the early history of ditch building in California. Some of these properties were repeatedly sold by the Sheriff to satisfy the debts that had accrued against them; each of these sales marking the lifetime of a new proprietorship and the end of an unavailing struggle to save the undertaking from impending ruin and the owners from bankruptcy. Of late years, however, fewer of these enterprises have proved failures, those undertaking them having been able to make their calculations with more certainty than was possible at a time when the prices of labor and material were inordinately high and so little was known about the resources and requirements of our mines, or other conditions essential to success.

NUMBER, CAPACITY, AND COST OF DITCHES.

Taking thirty of the principal ditches in the State of California, we find they have an aggregate length of 1,600 miles, have a carrying capacity of 100,000 miners' inches of water, and cost, tributary ditches, reservoirs, and other appendages included, a total of about \$20,000,000; the smaller ditches, which are much more numerous, having, with their appurtenances, cost at least half as much more. Connected with the most of these ditches, are one or more reservoirs, and also a greater or less area of mining ground, some of the larger companies owning several hundred acres. The largest tract of mineral land appurtenant to any one system of ditches in the State comprises 7,700 acres. It is owned by the Trinity River Canal and Hydraulic Mining Company, the property comprising a part of the estate of the late Thomas H. Blythe. The most of this land is held under United States patents, a large proportion of it being gold-bearing. Connected with this property is a franchise to the entire water flow of the East Fork of Trinity River, and several other large streams in the vicinity, amounting, when these streams run moderately full, to about sixty thousand miners' inches of water. Most of the water rights belonging

to these ditch companies are very valuable properties, inasmuch as they are perpetual, and the water they cover will always be required for either mining or agricultural purposes, if not for both; in which view their value will not be likely to suffer depreciation in the future.

STORING AND DISTRIBUTING RESERVOIRS.

From the middle of April to the middle of November, the rainfall is, as a general thing, inconsiderable in California. By the time these seven months are one-third past, the most of the smaller streams have dried up altogether, and even the larger are so diminished in size that they can supply but little water to the ditches dependent upon them for replenishment. For the purpose of catching and storing the water while yet abundant, and thus prolonging the working season of the hydraulic miner, the plan of building large reservoirs has been adopted by all the leading companies having at the head of, or adjacent to the lines of their ditches eligible sites for such structures, as the most of them have. Some of these reservoirs are works of great magnitude and importance—costly, capacious, and secure; those belonging to the North Bloomfield, the Milton, the Eureka Lake and South Yuba companies being much the largest in the State. These receptacles are filled during the rainy season, or when the snow is melting on the mountains, at which times there is a great surplus of water, infinite quantities of it running to waste every year. Each of the companies mentioned, as is the case also with some others, has constructed several of these basins for the impounding of water, and which, with their retaining dams, form a very extended and perfect system of depots, none of which, except in extremely dry winters, fail to get filled.

The most extensive and complete as well as the most costly of these systems of waterworks, is that of the North Bloomfield Company, whose several reservoirs hold very nearly one billion cubic feet of water, the most of it being

contained in the Bowman Reservoir, the lowest and largest of the group. The dam for retaining the water in these reservoirs have cost over a quarter of a million dollars. In the construction of the Bowman Dam, one hundred feet high, there were employed fifty-five thousand cubic yards—eighty-five thousand tons—of material, mostly rock, the outer walls being built of roughly dressed stone. The catchment basin that feeds this reservoir covers an area of twenty-nine square miles, the annual precipitation on which, rain and snow included, averages about seventy-eight inches, three-fourths of which runs into the reservoir. Being at an altitude of over six thousand feet above sea level, the snow falls here to a considerable depth in the winter, and lasting till the warm weather comes on, makes much summer water. The Eureka Lake and Yuba Canal Company, by damming up the outlets to several small lakes, have converted them into capacious reservoirs, holding an aggregate of eight hundred and twenty million cubic feet of water, the several reservoirs of the Milton Company, in the same neighborhood, having a still larger aggregate capacity. The South Yuba Company have two extensive reservoirs, the one formed by damming up the outlet of Meadow Lake, and the other by a similar structure thrown across the outlet to Fordice Valley, the water catchment to the two covering over one hundred square miles. Several other companies have each one or more reservoirs of considerable capacity, and but for the provisionary supply stored in these immense magazines, the hydraulic mines would be doomed to inactivity during the later summer and earlier autumn months, the most favorable season for carrying on this class of mining operations.

Distributing reservoirs, though of inferior dimensions and not always indispensable in the case of the smaller ditches, become a necessary appendage to the larger ones, being located near the mine and there used to receive and hold the water from the ditch, ready to be let on and shut off as required. They also receive and retain the water

when piping is suspended for the purpose of cleaning up, shifting the giant, making repairs, etc.. which water otherwise would run to waste. There always is, or should be, a number of these minor reservoirs attached to every large ditch.

THE NORTH BLOOMFIELD TUNNEL AND ITS AUXILIARY SHAFTS.

The bed rock tunnels run for securing outlet for these deep-lying gravel channels, vary in length from five or six hundred to three or four thousand feet, the only one in the State having a greater length than this being that of the North Bloomfield Company, which reaches the extreme length of eight thousand feet. As this enterprise, which had the benefit of ample capital and an able management, well illustrates the character of this class of improvements and the methods of their construction, a short description of the above work might not, in this connection, be out of place. Possessing a large area of gravel situate on a rich and extensive "dead river" channel, the owners of the North Bloomfield ground, some ten years ago, devised a plan for opening it up by means of a bedrock tunnel. With a view to prospecting this ground and ascertaining the position and depth of the channel, four shafts were sunk to bedrock. The first of these shafts, the only one that struck the main channel, disclosed a body of gravel two hundred and seven feet deep, of which the lower one hundred and thirty-five feet consisted of the blue variety characteristic of the bottom strata of the old river channels, though these seldom occur of such thickness as here. From the bottom of these shafts some two thousand feet of drifts were run with the course of the channel, which was shown to be about five hundred feet in width. The gravel extracted from these drifts and shafts, twenty-one thousand six and hundred fourteen tons, yielded thirty-six thousand six hundred dollars in gold; the entire cost of this preliminary labor having been sixty-three thousand nine hundred and fifty-six dollars.

This data obtained, a tunnel was located and commenced. As a means of facilitating and hurrying forward this work, eight double compartment shafts were sunk along the line of the tunnel, one of these compartments having been used for hoisting and the other for pumping. These shafts, which are four and a half by nine feet in the clear, and heavily timbered throughout, stand from eight to nine hundred feet apart, and have an average depth of one hundred and ninety-seven feet. The hoisting and pumping machinery was driven by hurdy-gurdy wheels, eighteen to twenty-one feet in diameter, the water brought in heavy iron pipes from the company's ditch, having been delivered under pressures varying from two hundred and forty to five hundred and fifty feet.

For six thousand feet in from its mouth, this tunnel is six and one-half feet high and six feet wide, the balance eight by eight feet. The work of excavation, performed mostly by machine drills, was advanced simultaneously from sixteen different faces, the total progress made having averaged over one hundred feet per week. The ground proved very wet, nearly five hundred thousand gallons of water having been raised every twenty-four hours. An average of one hundred and sixty men were employed on this tunnel for over two years; the entire cost of the work, including construction of shafts, hoisting and pumping, machinery, etc., having amounted to over half a million dollars.

The management of the enterprise was committed to Hamilton Smith, Jr., who, from its inception throughout, acted in the double capacity of superintendent and engineer.

OTHER EXTENSIVE TUNNELS.

While the above described is much the longest, as well as the most costly tunnel in the State, there are still a number of others, each ranging from three to four thousand feet in length, and some of which have cost at least half as much as that of the North Bloomfield company.

The Gold Run Ditch and Mining Company, Placer County, have completed a system of bed-rock tunnels, eight feet by ten, and aggregating over four thousand feet in length. The Cedar Creek company, at Dutch Flat, in the same county, have well advanced the construction of a similar system of tunnels which, when completed, will aggregate a length of nearly four thousand feet. At the Nevada mine, near You Bet, Nevada County, a bed-rock tunnel, nearly three thousand feet long, was driven several years ago. For opening up the leading hydraulic mines at and around Smartsville, Yuba County, several tunnels of this kind, running from two to three thousand feet in length, have been excavated. Though run with the diamond drill, their construction was, in every instance, attended with heavy expense, the bed-rock in that district being exceedingly hard.

The cost of these structures varies everywhere with length, size, and the character of the rock to be penetrated, running all the way from twenty to sixty dollars per linear foot. The drilling in these tunnels, formerly done by hand, is now performed by power-driven machines, the Burleigh drill, propelled by compressed air, being the machine most in use.

Except where the bedrock is so hard that it will not readily wear into holes, sluices are laid down along the entire length of these tunnels. Eighteen hundred feet along the upper end of the North Bloomfield Tunnel has been set with block-paved sluices, the balance, a tough slate, having been left bare.

BLOWING UP THE HIGH BANKS AND THE HARD GRAVEL WITH POWDER.

Where the gravel to be handled is found so hard that it cannot be easily piped down and disintegrated with water, and when in the progress of washing the banks become so high that they cannot be run off with convenience and safety, the plan of breaking them down and shattering them to

pieces with powder is resorted to. This mode of dealing with these deposits, when the above untoward conditions supervene, was first introduced in 1860 by James P. Pierce, an experienced and successful hydraulic miner, and a pioneer in the business. Prior to the above date the gravel banks were caved down, being undermined with picks, a tedious and dangerous method, the standing mass sometimes giving way suddenly and burying up the workmen. Having conceived the idea that this work could be accomplished at less cost and with greater safety to human life by means of gunpowder, Mr. Pierce proceeded to test the matter in a practical manner. The experiment, though conducted in a comparatively small way, was attended with such satisfactory results that the new plan came into general use. The charges, small at first, were gradually increased as the utility of enlarging them became apparent, and such progress had been made in this direction that in the course of ten years as much as fifty thousand pounds of powder had come to be fired at a single blast, the introducer of this method having in the month of December, 1870, exploded that quantity in the Blue Point Gravel Mine, near Smartsville, where his first trial was made.

Where the material to be broken up presents a flat surface instead of a perpendicular bank, or the body of gravel is quite shallow, a vertical shaft is sunk into the mass to a depth of fifteen or twenty feet, and a small chamber excavated at the bottom of it. Into this chamber five or six kegs of powder are placed, thoroughly tamped, and fired by electricity. A blast of this kind will pretty thoroughly shake up an area of ground from thirty to fifty feet in diameter.

Where recourse is had to drifts, a main adit is run in for a distance one and a half times as great as the height of the bank to be broken down. From the inner extremity of this adit, and at right angles with it, cross drifts are driven, their united length equaling that of the main adit. Occasionally the cross drifts are turned at their ends and run for

a short distance parallel with the main drift, forming a perfect T. Where very large quantities of powder are to be used, a second and shorter set of cross drifts, half way between the first and the face of the bank, is sometimes run. Generally, however, a single set of drifts of this form (T) is considered sufficient. The quantity of powder required for a charge depends on the kind employed and the height and hardness of the bank to be shattered, two-thirds of a keg of blasting powder per one thousand cubic feet of gravel covered by the drifts being, as a general thing, sufficient. If enough is used to blow out the bottom gravel, the line of least resistance, the mass above, falling by its own weight, must be pretty effectually crushed, where the bank to be shattered is from eighty to one hundred feet high. Where the bank to be shattered is one hundred feet high, the main drift should be at least one hundred and twenty feet long, and always in about that ratio, so that the top pressure may be proportionate to the lateral or front pressure, and a general upheaval, instead of a blowing out of the front, or but a partial blowing up of the top, may ensue. These drifts are made no larger than the convenience of the workmen requires, being usually about three by four feet. Of the Judson powder, an explosive that is coming into extensive use for bank blasting, a much less quantity suffices than of ordinary black powder. The Judson powder is, by many experienced miners, preferred to every other, being recommended both for its greater economy and efficiency. Giant powder has occasionally been used for bank blasting with good effect. Where it is employed, each separate lot must be closely tamped, so as to wholly exclude the air. Though much more expensive, one pound of this powder will do as much execution as five or six pounds of ordinary powder.

In charging the drifts, the kegs or boxes of powder are placed along them in rows. The tops of the middle row of packages, whether kegs or boxes, are then removed, and two wires laid along them and connected with others

that extend to the electric battery with which the explosion is effected. From eight to twelve electric fuses are equally distributed and buried in the powder. Where the Judson powder is used, the exploders are inserted in giant powder caps and laid on top the paper covering by which this explosive is protected from moisture.

FIRING THE BLAST, AND ITS EFFECTS.

The powder having been properly disposed of, and the wires and fuse adjusted, a bulkhead of timbers is placed across the main drift at the point where the lateral arms intersect it, after which it is tightly packed to its mouth with sand and gravel, experience having shown that the tamping should be effectually done. Everything having been thus gotten in readiness, the conductors are connected with the electro-magnetic battery placed at a safe distance. A few turns of the crank, and instantaneously the entire mass of powder is exploded. The report that follows is not loud, nor is the concussion violent, the latter being deep and far-extending, like the shock of an earthquake. The surface of the mined ground lifts a little, the lower portion being thrown outward, after which the whole, settling with a heavy thud, moves and crumbles for some moments, great clouds of dust mingled with powder fumes ascending meantime and obscuring the atmosphere. With such safety are these operations conducted, that no fatal or even serious casualty has ever occurred in connection with them.

The following examples of blowing up gravel banks with powder, and their results, are here alluded to, not because the list includes all or even a small portion of the heavy blasts that have been fired in California, but for the reason that they cover a considerable period of time, represent a number of widely separated localities, and fairly illustrate the mode of procedure as well as the effects generally produced by this class of operations.

The fifty thousand pound charge exploded in the Blue Point mine, in December, 1870, consisted of black powder,

and was the largest that, up to that time, had been set off in the State. The underground passages excavated for receiving the powder on that occasion, were composed of a main drift two hundred and seventy-five feet long, and four cross drifts, fifty feet apart, and each having a short arm, eighty feet, and a long arm, one hundred and twenty feet in length, the height of the bank being seventy-three feet. These drifts were of uniform size, three feet by four. The powder having been evenly distributed throughout the drifts, and the heads removed from the kegs, a cartridge was inserted in a keg of powder in each of the cross drifts, making ten points at which the charge was fired simultaneously. The blast was discharged by a galvanic battery, the wires extending along the main drift having been carried through each of the lateral drifts, passing in along one side and out along the other, connecting in their passage with the cartridge placed in each drift. The quantity of earth loosened up and brought into good condition for piping by this blast, amounted to one hundred and fifty thousand cubic yards. Again, in 1877, nearly eleven hundred kegs of powder were in like manner exploded in this mine, and with equally good effect.

In 1872, three thousand five hundred pounds of Giant Powder, No. 2, were fired in the Harriman and Taylor claim, at Gold Run, Placer County, throwing down and disintegrating two hundred thousand cubic yards of gravel. At the Paragon mine, near Bath, in the same county, a blast of seventeen thousand five hundred pounds of common black powder was shot off in 1874, doing good execution, some two hundred thousand dollars having been extracted from the gravel broken up by it. The drifts run for the reception of this powder amounted to three hundred and twenty-five linear feet. From the inner extremity of the main adit, which was one hundred and ten feet in length, an arm was extended in one direction seventy, and in the other sixty feet. From the end of the former a drift was run toward the face of the bank fifty-five feet, and from the end of the lat-

ter a like drift was run thirty feet. In the longer drifts run to the right of the main tunnel, there were placed four hundred kegs of powder, and in those to the left three hundred kegs. The main tunnel was tamped for a distance of seventy-five feet in from its mouth, and the lateral drifts each ten feet. The entire set of drifts was four and one-half feet high, and five feet wide, the bank above being one hundred and fifty feet in height. The electrical machine used for firing this blast was placed four hundred and fifty feet from the mouth of the tunnel, the length of wire laid down for making the circuit amounting to one thousand five hundred feet.

The Nevada Reservoir and Ditch Company, operating at Sucker Flat, Nevada County, put off, in the early part of January, 1879, one thousand boxes—fifty thousand pounds—of Judson powder, disrupting and thoroughly loosening a bank of auriferous gravel two hundred feet high. From the gravel broken up there was subsequently washed out one hundred and fifty thousand dollars. The charge here employed would equal in force about one hundred thousand pounds of common blasting powder.

In the month of November, same year, there were exploded at a single blast, in the Dardanelles Hydraulic and Drift mine, near Forest Hill, Placer County, thirty-six thousand pounds of Judson powder, whereby some five hundred thousand cubic yards of cemented gravel were lifted up and shattered to pieces. Into the face of the bank, which was about one thousand feet long and one hundred and seventy-five feet high, there were driven five parallel adits, across each of which there were carried two or more lateral arms, the whole amount of drifting having reached a linear extent of one thousand two hundred feet. The powder, divided into lots weighing from one thousand to one thousand five hundred pounds each, was deposited in twenty-eight different chambers, into each of which were placed three exploders, all connected by insulated copper wires with the outside wires leading to a large electro-magnetic

battery, set on a slight eminence about two hundred feet from the face of the bank. In the month of May, 1880, Superintendent Waldeyer set off in the Spring Valley mine, at Cherokee, Butte County, twenty-five thousand pounds of Judson powder, which performed its work well, doing all that was expected of it.

In the Blue Tent mine, Nevada County, there were consumed in the course of the year 1880, a total of sixty thousand pounds of black, and four thousand pounds of Giant powder; there having been fired there during the year two blasts, at each of which there were burned twenty-five thousand pounds of black powder. In the early part of 1881, this company blew up a gravel bank nearly two hundred feet in height, using for the purpose one thousand seven hundred and twenty kegs of black powder, containing twenty-five pounds each, a total of forty-three thousand pounds.

The foregoing examples, not to mention many others of like import that might be cited, serve to show the progress made in the use of these various explosives for shattering the indurated gravel deposits in California, and the extensive scale on which these disrupting agents have come to be employed for that purpose.

DISPOSING OF THE HIGH GRAVEL BANKS IN BENCHES.

As washing progresses, the gravel banks, through the pit being advanced into the hill or opened downward, become often so high that the entire mass cannot, at a single operation, be piped down with economy of labor or safety to the workmen. Where this occurs the bank is disposed of in benches, the upper half being first attacked and run off, and the balance afterwards. When the bank gets to be much over a hundred and fifty feet high, this is usually the method adopted for handling it. In many localities the banks of gravel in the course of washing come to be as much as two hundred and fifty or three hundred feet high. At a

number of places on the Forest Hill Divide, about Gold Run, Dutch Flat, and You Bet, at North Bloomfield and elsewhere along the San Juan ridge, also around Smartsville and at Cherokee, Butte County, the hydraulic deposits run from one hundred to three hundred feet in depth. At some points in Trinity County they reach even a greater depth than this. On Buckeye Mountain, a high ridge lying between Stewart's Fork and Rush Creek, in that county, the gravel is supposed to be fully five hundred feet deep, and slightly auriferous throughout. Where this material reaches such extreme depths, the bulk of it is very apt to be of rather low grade.

Since the adoption of this plan of running off the high gravel banks in benches, accidents, in consequence of their caving and burying up the workmen, have rarely happened, though before this such casualties were of frequent occurrence.

VARIOUS MINOR MECHANISMS AND DEVICES.

The plan of filling reservoirs and then hoisting the gates and letting the water escape in a flood, as practiced by the ancients, has its counterpart in the "self-shooter," so called, a contrivance through the use of which the opening and shutting of the reservoir gate becomes automatic. These devices are in use in some of the northwesterly counties of California, and still more extensively in certain parts of Colorado, where this method of collecting and discharging water is called "booming," an appellation more expressive of the manner in which the machine does its work, and less suggestive of suicidal intent than the name given to it in California. This self-acting gate, which is not much employed, except in localities where water is scarce, and labor requires to be closely economized, may be described as follows: To the upper edge of the gate, which consists of a heavy piece of canvas, a rope is attached that passes up over a five foot pulley fixed above the dam, and thence back fifteen feet over a much larger pulley, dropping

down from which its end is fastened to a large wooden box or cistern. A small flume extends from the upper edge of the reservoir to this box; when the reservoir is full, the water flows out through the flume into the box, which, as it fills up, moves downward, raising the canvas gate, and letting the water out into a race, which carries it down to the mine. Meantime, the water in the box having escaped through holes in the bottom made for the purpose, the box ascends, being raised by a weighted lever attached to the axle of the smaller pulley. With this action, the canvas gate drops again to its place, and the flow of water being here arrested, the reservoir fills up, once more repeating the process above described. The advantages of this mode of "booming," are, that all the water is saved, while the services of a gate tender are dispensed with. The above is the style of this device as rigged up in Colorado, a long sweep and wooden gate being, in California, substituted for the canvas gate, rope and pulleys, the latter much the better arrangement.

Besides these more costly and powerful methods, appliances and improvements, as hereinbefore described, many others of minor importance, but all more or less useful, have, from time to time, been introduced into the business of hydraulic mining. Among these devices of secondary consideration, the following may be cited as constituting some of the more noteworthy, viz: the hydraulic elevator, through the agency of which the water, under great pressure, besides being used to break down and wash the gravel, is also made to force it up through an iron tube to heights proportioned to the amount of pressure and the volume of water at command, the lift, through the more recent and improved machines being at the rate of about thirteen feet vertical for every hundred feet of pressure employed.

This machine is especially serviceable for utilizing the gravel on low flats and bars lacking dump; also, gravel resting in deep basins devoid of outlet, and which could not otherwise be worked except by the aid of long tunnels driven through the inclosing rim-rock. A number of these eleva-

tors are now running in different parts of the State, the most of which accomplish their work, where properly managed and the conditions are favorable, in a satisfactory manner.

In this category we have also the various styles of the machine drill, by means of which long drifts and tunnels can now be driven at much less cost than formerly, effecting what is hardly less important, a great economy of time as well. The substitution of the electric light for the pine torch and bonfire of other days, has much advantaged the companies adopting it. The introduction of the telegraph and the telephone is proving a great convenience to the many large hydraulic and drift companies who have furnished their works with one or both of these methods of rapid communication.

But lack of space forbids further enlargement of the list of these auxiliaries which have enabled the hydraulic miner to so largely reduce his expenses, increase his revenues, and add to the security of life and limb, while they mitigate the severity of his labors.

Whole chapters might be written on some of the powerful implements and inventions that in the foregoing pages have barely been mentioned, to say nothing of others almost equally deserving that have not even been alluded to; but as we have so overlooked much of the effective enginery that the hydraulic miner has called to his aid, so also has nothing been said of the many novel contrivances and worthless machines with which he has one time and another been induced to experiment, to the great detriment of his business and the depletion of his pockets.

The yield of the gravel run off in the larger hydraulic mines of this State has varied from five to thirty cents per cubic yard, the average having been about fifteen cents. A miner's inch of water, under ordinary circumstances, will wash from $1\frac{1}{4}$ to 4 cubic yards of gravel—average, say, 3. The yield per acre varies, of course, with the richness of the gravel and the depth of the banks, which range from 30 to 300 feet. On an average an acre contains about 100,000 cubic yards, and yields a total from ten to twenty thousand dollars.

THE DEBRIS QUESTION.

It is unfortunate that so many of our hydraulic mines, after this system had been at such heavy expense so developed and perfected, have been enjoined from running by process issued from the courts, as these proceedings have not only entailed heavy loss upon the owners of these mines, but caused great suffering to the communities where they are situated. After years of litigation with varying results, there appears to be at this time a growing public feeling in favor of the miners. As evidence of this we quote the following remarks published March 7th, 1885, in the *Mining and Scientific Press*, a paper distinguished for its intelligent but conservative views on everything relating to mining matters:

"SHOULD BE SETTLED BY LEGISLATION.

No person who mixes much with the more intelligent portions of this community can fail to have noticed how generally the decision of Judge Sawyer, in the Mining Debris suit, is condemned even by parties having no direct interest in the issue of that suit. Not that this opinion is always demonstrative, or even very pronounced, yet a conviction that an injustice has been done the hydraulic miners appears to be fixed and wide-spread, showing that the public conscience is uneasy on the subject, and that it cannot be reconciled to a policy which, if adhered to, must inevitably work great hardships to so many of our citizens. Nobody questions the motives, the learning or the ability of Judge Sawyer, yet nearly every body seems to feel that a great wrong has been done, and that it ought to be righted. The law may be against the hydraulic miners; the farmers may assail, and the newspapers denounce them, and still this latent sympathy will continue its spontaneous workings among the disinterested masses. Any judicial finding that fails to take in a fair share of the equities on both sides can never be final. The trouble in such settlement of issues is

that they will not stay settled. Every rank injustice resurrects itself after it is thought to have been committed to final sepulture. Even when passed on by the court of last resort, a case of this kind is not disposed of. After it has been adjudicated by this tribunal, the party feeling aggrieved will appeal to the law making power for relief. Here is where it must ultimately go for correction, be the results in the courts what they may. As the representatives of the people, any action taken by the Legislature would, as embodying public sentiment on this subject, presumably prove satisfactory to all.

This being the case, the bill introduced by Senator Cross at the last session of the Legislature, and which, having been favorably reported upon by the committee on mines, to whom it was referred, ought to have been enacted into a law. This bill provides that parties interested in hydraulic mining may incorporate for the purpose of building dams and other works for retaining and impounding the debris from such mines, authorizing them to take under the law of eminent domain any ground required in the construction of these works. All moneys needed to the above end are to be raised by assessment of the stock of the companies, ten per cent. thereof being made payable to the State Treasurer to raise a fund out of which the dams are to be kept in repair, in case this should not be done by the companies. After these retaining structures have been built, it is, of course, understood that the hydraulic miners who have been stopped running shall be allowed to resume operations.

With a law like this, the miners would be restored to the status they occupied under Judge Temple's decision, who held that as soon as the *heavier* debris is completely impounded, the miners may again go on with their work. Judge Sawyer, on the other hand, made his injunction perpetual, suggesting that, if in the future any plan were adopted whereby the injuries complained of could be *wholly obviated*, then the court might be induced to modify the decree, or possibly suspend the injunction altogether. This

is looked upon as equivalent to saying that work under no possible circumstances shall be resumed, inasmuch as the miners could not so effectually impound these slums that no injury whatever could result to interests and properties below.

It is not our purpose to discuss at length the merits of a question that has already been so thoroughly investigated in the courts, but to merely invite public opinion to the fact, that it would be to the interest of all that it should be disposed of by the Legislature, which can better deal with all the facts and equities in the case than it would be possible for the courts to do. This is a case in which the concessions cannot all be wrung from one side. Each must yield, and each suffer something. To attempt its adjustment on any other basis is simply to make it a judicial heirloom that would lead to interminable contests between two of the leading industries of the State."

There can be no doubt but the *Press*, in the above article, takes the correct view of the subject, and that such legislation as is here suggested would meet with the approval of a large majority of our citizens.

The following statements, copied from a San Francisco paper, present

SOME OF THE ARGUMENTS IN FAVOR OF THE HYDRAULIC MINERS IN A CONDENSED FORM.

"Gold was discovered in California in the spring of 1848, and two years later we had a great influx of population from all parts of the world, in which unfortunately the so-called Celestial Kingdom was largely represented. Our mountain streams swarmed with gold seekers of all Caucasian nationalities, and for many years they pursued their labors with no other thought than to make a stake and "go home." But not so with John Chinaman; he came here to stay—and here he is yet, a plague more destructive than the seven plagues which inflicted Egypt. Not content with invading

all fields of manual and mechanical labor, he has now acquired our gold producing territory, and driven the white miners of our State to the last extremity of poverty.

The many thousands miners of those early days worked on every river, creek, ravine and gulch, doing, by the mere effect of their combined labor, more potent work in contributing to the filling of the mining rivers than all the improved monitors which were in use ten years later. All the material disturbed by them in their search for gold found its way into the beds of unnavigable streams, whence in seasons of high water a portion was transported to our navigable streams, and to some extent covered bottom lands, and as the river beds rose by the deposit of sediment, induced the building of levees to keep the water in channel. But the experience of other civilized countries, when settled and cultivated, shows the necessity of such levees, even where mining is unknown—witness the rivers of Italy, and in our own country the Mississippi and its tributaries.

When the great rainfall of 1862 came, it swept the accumulated mining debris of fifteen years from its place of deposit in the mountain streams to the lower country, and considerable damage resulted to improvements on low lands. But floods had been periodical in California. The officers of the Russian exploration expedition of 1824, reported to their Government that the valley of the Sacramento was uninhabitable, by reason of these periodical floods, and this opinion was partially endorsed by Commodore Wilkes' exploration in 1842.

The actual amount of damage has never been judicially determined. It is claimed by the miners that it has not in the aggregate exceeded one million five hundred thousand dollars; and that this is offset by the reclamation of land hitherto valueless; for slickens covered land—especially if it has been covered a few years—is now in demand. As a producer of hops, potatoes, and many varieties of fruits and vegetables, it has no equal.

But aside from this—an insignificant consideration—it must be remembered that this mining industry—now closed to all but Chinese—has yielded (as judicially found) some twelve hundred millions of dollars worth of gold, and could have been relied upon for an annual production of twenty millions per year for an indefinite period—say at least half a century. Of this, twelve millions came from mines worked by the hydraulic process. The interference with this class of mines, by Judge Sawyer's decree, combined with the annoyance caused by a local Court in the County of Yuba, presided over by a judge elected by the anti-miners on this special issue, has so far deprived twenty thousand white miners of the means of livelihood in a few counties alone, and probably ten thousand more were frightened away from their work and homes in other counties.

What are the results: Desolated homes; vacant school houses; the churches closed; the merchants transformed to itinerant peddlers; no work for white miners—while Chinese swarm in the desolate camps, and work the enjoined mines with impunity, while the white miner has become a tramp.

But few residents of our city have any conception of the magnitude of the destroyed mining district. Suffice to say it has been judicially found by both Judge Temple of the State Court and by Judge Sawyer of the Federal Court that at least one hundred millions had been invested in our hydraulic mines alone. And this was not a stock investment or "gamble," but represented an outlay of coin for reservoirs, ditches, tunnels, etc., constituting the permanent "plant," and did not include the working pay-rolls of the mines. As stated in my former communication about thirty thousand whites were dependent on this industry directly, and I doubt not that twenty thousand more indirectly. Should you cast a stone in a quiet lake the ripples will surely reach the most distant shores, and so we, of San Francisco, have been affected from such remote causes.

It has been asserted by the opponents of hydraulic mining: (1) that the mines did not pay expenses; (2) that they em-

ployed Chinese labor; and (3) that they were owned by foreigners. The term "falsehood" is too mild to apply to such statements—they are lies.

The refutation of these statements may be concisely presented in a few lines: (1) If the mines did not pay they would long since have been abandoned, and the owners would not have carried on nine years of litigation, which has cost them nearly three hundred thousand dollars. (2) It is false that Chinese labor was employed on the enjoined hydraulic mines. The records of two of the principal mines on the San Juan Ridge, the North Bloomfield and the Milton, show that from five hundred to six hundred white men were employed at average wages of three dollars per day; also skilled labor at the rate of four to five dollars per day—and no Chinese. I have no accurate data at present respecting the Eureka Lake, Excelsior, and other large companies on the Yuba, but estimate that in the aggregate the enjoined companies on the Yuba River alone employed at least two thousand white men—and these were by selection and preference men of family who had their homes near the mines, and I do not herein include Sierra and Plumas Counties. (3) That our mines were owned by foreigners is false. They were opened by California enterprise, energy, skill and capital, and most of the promoters and owners of these great works are still residents of San Francisco. But suppose they were foreign corporations—the laboring man is not averse to taking his wages from "foreigners." It is better than starvation, or giving his place to Chinamen.

The hydraulic miners purchased their lands from the Government, paying double the price of non-mineral lands, after they had paid the locators large prices for the same land. Their patents carry at the head a vignette representing a row of monitors (large hydraulic nozzles) playing against a bank of auriferous gravel. The land was sold with the knowledge that its gold could not be extracted with profit by any other than the hydraulic process. Their patents are a concession from the Government, and they now simply ask

the use of their property. On the faith of these patents they have run long tunnels, constructed immense water reservoirs, and built many hundred miles of ditches, at a cost of about one hundred million dollars. The result of their work was to build up prosperous and permanent communities, and for themselves a reasonable interest in their investment. They have shown a disposition to so use their property as not to injure another, and ask the privilege to contribute from their own means as much money as the Government will appropriate for the future protection of the navigable streams. For the past they are not responsible.

Opposition to hydraulic mining is not the policy or sentiment of the people of this State, nor of the inhabitants of the valleys. It emanates from a close ring whose headquarters are in the small town of Marysville, and whose numbers are insignificant. Our gold product saved the credit of our country in its greatest crisis—the rebellion—and public policy forbids that it should be arbitrarily cut off because a goat pasture has been injured."

DRIFT MINING.

WHAT IT CONSISTS OF, AND WHEN TO BE EMPLOYED.

This term, as has already been explained, is used to designate that mode of operating whereby the deposits of auriferous gravel are reached by means of shafts, inlines, or tunnels, and having been dug or drifted out, are afterwards through these openings brought to the surface and washed in sluices; the methods here in use being similar to those employed in coal mining. As in the latter, we have in these drift diggings galleries and gangways, adits and shafts, either horizontal or inclined, with a variety of other aids and appliances common to both. In both, the contents of the mines lie flat, or nearly so, necessitating roof supports, while in both these contents are broken out mostly with the pick and gad, and removed to the surface in cars run over tramways.

Whether a deposit of auriferous gravel is to be worked by the hydraulic or the drift method, depends on the following considerations: first, the manner in which the gold occurs—that is, whether it is mostly confined to the bottom stratum, or whether it is generally distributed throughout the entire bank, or a large portion of it; also, whether there is, superimposed upon the deposit, any large amount of lava or any other hard or barren matter, and finally, the facilities that exist for outlet or dump, and the quantity of water easily available for washing purposes. However much gold the gravel bank may contain in the aggregate, if diffused throughout the entire mass—if the pay dirt is covered up with great quantities of worthless material, if there is lack of fall below the mine or an insufficiency of water for working it, the deposit will have to be worked by

the drift method, or if undertaken by the hydraulic the enterprise must result in early failure.

In hydraulic mining, as we have seen, the entire body of auriferous gravel is broken down and run off, nothing but the larger boulders, with occasionally some masses of pipe clay, lava, or other barren and unwieldy material being left behind. In drift operations, on the contrary, only a thin stratum of the rich bottom gravel from three to five feet in thickness, is ever taken out or at all disturbed, it being in this stratum that the most of the gold is found.

EARLY HISTORY OF THE BUSINESS—THE FATAL MISTAKES THAT LEAD TO MANY FAILURES.

Tracing this style of mining to its incipency, we find its origin in the practice, early begun, of following the rich streak of gravel under the river banks by means of rude excavations, supported mostly by boulders, which manner of searching after and gathering gold was, in the not very elegant vocabulary of the day, denominated "Coyotying." Not, however, until about 1852 or 1853, did operations by this method take the form of a distinctive branch of mining; the discovery of the old river channels about that time having opened a wider field and imparted to it an unwonted activity. Spreading rapidly, great numbers of shafts and tunnels were started along these old channels, western Sierra, central Nevada and some portions of Placer and Tuolumne counties having been the sites of most of these works, sixty per cent. of which brought only disappointment to the projectors, more than a third of all undertaken having proved signal failures. These failures were, as a general thing, caused by the tunnels run for opening up and draining this class of claims, having been driven on levels too high to effect these objects. At that day the plan of putting down shafts to ascertain the position of the deposits and thoroughly determine in advance the proper level on which to run the tunnel, had not yet come in vogue. As

the further up the slope of the hill these tunnels were located the shorter they would require to be, the miners, through their desire to economize time and expense by making them as short as possible, were apt to be betrayed into the fatal mistake of locating them too high, a mistake that cost many of them very dearly.

As capital had not thus early begun to embark in enterprises of this kind, these exploratory works were mostly undertaken by the miners themselves, who, in carrying them on, proceeded after something like the following plan: Small companies, usually from ten to twenty, entered into a partnership with a capital stock consisting of a limited number of shares, not more perhaps than three or four times as many as there were members in the company, each of whom took at least one share, such of them as had money taking two or more, according to their means. With the money realized from the sale of these shares, work was carried on as long as the funds lasted; when exhausted, the whole company, or a part of it, would break off and hire out or perhaps work some claim they might have in the neighborhood and earn money enough to keep up or resume operations on the work in hand.

With means so limited and liable to so much interruption, the business of driving by hand drilling long tunnels through the hard rock was necessarily a slow one, five or six, and often as many as eight or ten years having been consumed in the construction of one of these adits. Very severe then was the disappointment of these men when, as so often happened, they found that all these long years and their hard-earned money had, through the inutility of these structures, been spent in vain. By reason of these mishaps the business of drift mining was greatly retarded, and many a miner's purpose of making an early return to "the States," indefinitely postponed.

After a time, however, when these mistakes were fewer, the altitudes of the old channels having come to be better understood, this branch of mining began to pay better.

For many years large returns were made along the channel reaching from Minnesota through Chipp's Flat, Alleghany and Forest City, and thence on via Monte Cristo, into Plumas county. Very prosperous diggings of this kind have also for a long time been worked along either side of Slate Creek, in Sierra County, as well as at a number of other places in that vicinity. As a drift camp, Damascus, on the Forest Hill divide, has for the past ten or twelve years enjoyed a good reputation, there being a number of other places, both on that divide and elsewhere in Placer County, where the drift diggings are making satisfactory returns. Above Liberty Hill, along the ridge between Steep Hollow and Bear River, are several claims of this kind that are yielding moderately well. Some drifting is being prosecuted along Trinity River and at a few other points in Trinity County, but the business there, while paying fairly, has never been engaged in extensively or been marked by any very large success.

LOCALITIES OF DRIFT MINES AND THE MODES OF PROCEDURE ADOPTED IN EXPLOITING THEM.

As already remarked, no very extensive drift mining has ever been carried on elsewhere than along the channels of the "dead rivers" proper. Some drift operations have been prosecuted under the banks and bars of the present rivers, and along the buried side channels formerly occupied by these modern streams; but they have not been extensive, nor have more than a few of them ever proved remunerative, except along the Trinity and some other of the northern rivers, where the most of these undertakings have been attended with fair success.

Where practicable, a drift mine is always opened by means of a tunnel driven in from the side of the mountain or ravine where it is situated, and on a level, as near as it can be ascertained, with the bottom stratum of gravel, only fall enough being given to it to insure drainage. If the

tunnel happens to be located too low, it necessitates a double handling of the gravel, which after being brought out of the side drifts, has then to be dumped or dropped down into the cars run in on the main tunnel to receive it. If the tunnel be too high, then a winze or incline has to be put down from its inner extremity, and the gravel be hoisted in buckets through the winze, or be taken up in cars run on a tramway laid along the incline. If buckets are used instead of cars for bringing up the gravel, they are hauled up on slides, being pieces of square timber laid on the bottom of the incline a few inches apart, according to the size of the buckets used.

The tunnel, after having reached the channel, is continued up it, following its sinuosities and keeping as near the centre as possible. As it is desirable to maintain the tunnel on a uniform level as nearly as may be, it is sometimes in bed-rock and sometimes in the gravel above, as inequalities in the channel are met with. From the central tunnel lateral tunnels or drifts are run off on either side at regular intervals, usually of sixty feet. These side tunnels are then connected by others run parallel with the main tunnel, whereby the body of the gravel to be removed is divided up into elongated squares and brought into suitable condition to be *drifted* or *breasted* out, as the miners variously term this style of stopping. Along these avenues, as drifting proceeds, car tracks are laid down, unless wheelbarrows are used for bringing out the gravel, as in the case where the quantity is small. As fast as the stratum of pay-gravel is removed, the roof above is supported by timbers. As stopping advances the great weight of the mass above gradually settles down and closes up the excavation, this settling never taking place so suddenly as to endanger the lives of the miners. Occasionally the excavation is filled by the swelling of the bed-rock below, some of this material upon being exposed to the atmosphere expanding in a remarkable manner.

Owing to this singular property of certain rocks it frequently occurs that tunnels in other than the drift mines

become wholly or partially closed up within a short time after they are driven. Serious difficulty has, on this account, sometimes been experienced in keeping open the tunnels on the Comstock mines, some of which, if neglected, would have closed up completely within two or three years after they were run, while access to others has been maintained only by cutting away the constantly swelling rock, the expansive power of which crushes often the strongest timbers.

As the settling down of the roof of the mine would necessarily destroy the main tunnel, if some provision were not made to guard against such result, a strip of gravel some thirty feet in width is left along either side of it, affording it the proper protection and support. When the mine is worked out and ready for abandonment, the workmen, starting at the inner extremity drift out these remaining strips of ground, whereupon the unsupported mass above falls in, finally closing up the mine.

The length of time required for exhausting a drift claim depends on a variety of circumstances, such as the extent of ground to be worked out, facilities for getting out the gravel, number of hands employed, etc., the life of these mines enduring from six or eight to twenty-five or thirty years. Where a number of claims have been located on a strong and well defined channel, the course of which has been definitely ascertained, they are sometimes worked out in rotation, one company waiting till the next below them have exhausted their ground, when the parties owning above, instead of constructing a new tunnel, will acquire the right of way through the tunnel of their neighbors, who have for it no further use. Not often, however, has it been found expedient to so wait and attempt utilizing the same tunnel for opening and working more than one mine. But it is sometimes the case that no other outlet can be had for a mine than through the tunnel driven on the claim below. In some of the drift channels, the bulk of the gold is found within two or three feet, and occasionally even within one

foot, of the bed-rock. When this is the case, not over three or three and a half feet of the gravel is removed, just enough to enable the drifters to perform their work conveniently. Generally from four to six feet of the bottom gravel is rich enough to warrant its extraction, though, in a few instances, it is taken out to a height of twenty-five or thirty feet. Rarely, however, is drifting carried to a greater height than five or six feet. The portion of these channels, measured transversely, that have proved rich enough to warrant being worked, have varied from forty or fifty to six or seven hundred feet, the average width being about two hundred and fifty feet. The labor force employed by the drift companies varies, of course with the extent of the mine and the difficulties encountered in working it, ranging all the way from ten or fifteen up to one hundred and fifty, and occasionally as high as two hundred men.

REMOVING THE GRAVEL FROM THE MINE.

Where the gravel from drift mines is to be brought to the surface through vertical or inclined shafts, the kind of motive power to be used for that purpose depends on circumstances. If there is but little material to be brought out, it may be raised with a windlass worked by hand; if much, then horse, steam, or water power is employed; always the latter where it can be readily obtained, which, however, does not often happen. Where the gravel is removed through tunnels, no other force is required to propel the loaded cars, once they are on the main track, than their own momentum, the tunnel grade being usually such that specific gravity not only suffices to carry out the cars, but tends to so accelerate their speed that it has to be checked by means of brakes. In these cases, one man, unless the grade is very steep, brings out two or three cars, standing on the rear one, to which a brake is attached, and through the use of which the entire set is controlled. For returning the cars into the mine, men or draft animals,

generally mules, are employed; workmen, timber, tools, etc., being taken in on the returning cars. With so many brakemen and draft animals required for this service, a more cheap and convenient means for its performance has, in the larger mines, become a desideratum, which latter has in the case of the Bald Mountain Gold Mining Company been supplied through the employment of an underground locomotive, and with such satisfactory results that it may be expected other companies having large quantities of gravel to handle will have recourse to like means for its removal.

VALUE PER ACRE.

The value of the drift gravel worked throughout the State has ranged from twenty to eighty thousand dollars per acre, and from two to three hundred dollars per linear foot. The gravel extracted from the group of claims located near Forest Hill, and worked out prior to 1860, yielded at the rate of nearly quarter of a million dollars per acre.

From the foregoing, it will be seen that both hydraulic and drift, like every other branch of mining, are beset with many obstacles and difficulties, some being incidental and exceptional, while others may be considered inherent to and inseparable from the business. But with all these drawbacks, this class of deposits open to the local capitalist a tolerably good field for the investment of money, especially if the investor be familiar with these methods of mining, and is able to supervise or give to the business a good share of his personal attention. In these, above every other kind of mining, it is important that preliminary proceedings be conducted with care, while subsequent operations must be watched with a vigilant eye, the liability to mistake and the sources of loss being here very great. The auriferous gravel requiring to be worked by these methods is so abundant in California that it will probably be mined with profit for many years to come.

QUARTZ OR VEIN MINING.

CHARACTER OF AURIFEROUS LEDGES.

Before proceeding to describe the mechanisms, methods, and processes employed in the extraction and subsequent reduction of gold bearing quartz, it may be proper to remark briefly on the modes of occurrence of the metal in the rocks, and the distinguishing features of this class of veins as found in California. And first, it may be observed, that these veins do not, as a general thing, form a network cutting each other and the strata in all directions and inclining at all angles, as is apt to be the case in most other parts of the world, but, with few exceptions, lie parallel with the stratification of the slates, being enclosed between the beds, with which they conform both in strike and dip. The following remarks on this subject have been in good part compiled from "Cronise's Natural Wealth of California."

The gangue of the auriferous veins in this State is almost always quartz. Near the surface, the associate minerals are chiefly the oxidized ores of iron, copper, lead and zinc; the sulphurets of these metals, at depths beyond the reach of atmospheric influences, being of general occurrence; the latter are sometimes accompanied by arseniurets of iron, etc., and occasionally by rarer combinations, such as the tellurides of Carson Hill, Rawhide Ranch, and other localities. Sometimes the gold in the veins is distributed with remarkable uniformity throughout the whole mass of the gangue, while in other and more numerous cases the reverse is true. In some instances, portions of the foot wall prove the richest, while in others, that next the hanging wall is the more highly auriferous.

Often the veins are more or less banded in structure, in which case the gold is apt to lie in streaks parallel with the

banding of the quartz. Occasionally it lies mainly in "chimneys," or "chutes," having a pitch in the direction of the strike of the vein; and not infrequently there is the greatest possible irregularity in its distribution, some portions of the vein matter being extremely rich, while others immediately adjacent are almost entirely barren. In some spots the gold is coarse, while in others it is impalpably fine—much of the rock that pays well to work showing no gold whatever to the naked eye. Sometimes the vein-stuff adheres strongly to the walls of the adjoining country rock, so that the former cannot be removed without breaking off much of the latter; while, again, the cleavage or parting between the two is perfect and clean. Frequently the vein and the country rock are separated by a selvage or clay band several inches in thickness, a condition that greatly facilitates the removal of the former. Often the walls, as well as the surface of the vein, are marked with parallel striæ, showing the direction of dynamic action, the surface often being not only worn smooth, but even beautifully polished by this movement. The gold occurs distributed more or less throughout not only the hardest and most compact quartz, but also in the more soft and cellular portions thereof, it being also present to a greater or less extent in the various metallic sulphurets scattered through the veins, particularly in iron and arsenical pyrites where the latter occurs, both of these minerals being often extremely rich.

The gold is not, however, entirely confined to the limits of the metaliferous vein; frequently existing as well in adjacent portions of the wall rocks, sometimes to such an extent as to remunerate well the cost of extracting and working it. Cases have occurred, as at Carson Hill, where the soft slates adjoining the veins, for a foot or more in thickness, were found to be immensely rich, equaling in this respect even the richest portions of the quartz itself. But, although the quartz veins are everywhere the chief matrix of gold, they are not its invariable accompaniments. Within the past few years this metal has been found at certain localities in con-

siderable quantity, distributed throughout broad bands or patches of the metamorphic slates, unaccompanied either by quartz in notable quantity, or by any distinct and definite vein formation. In these cases the rocks are shown to have been highly impregnated with metallic sulphurets of various kinds, the most prominent of which, however, was iron pyrites. The slow decomposition and oxidation of these sulphurets, as the result chiefly of atmospheric causes, have in many places entirely changed the chemical character and consistence of the rocks, replacing many of their original constituents by others of a very different kind. By this process, too, the whole mass of rock has sometimes been so softened as to set free the particles of gold once contained in the sulphurets, leaving the rocks often stained with a variety of brilliant colors, due to the metallic oxides and salts resulting from their decomposition.

But this subject of the modes of occurrence of gold *in situ* in the rocks, and other questions connected therewith, although exceedingly interesting, form too broad a field to permit of further consideration here; wherefore, we proceed to notice briefly the principal means and methods employed in the mining and subsequent treatment of the ore.

ORE EXTRACTION AND REDUCTION.

As the extraction of auriferous quartz does not vary materially from other vein mining as practiced in different parts of the world, it hardly requires a special description in this place. When the vein is so situated that it can be reached, at a considerable depth below its outcrop, by means of a tunnel extending nearly horizontally from the hillside or from an adjoining valley, such a tunnel or adit is first driven, drifts being afterwards extended from it in each direction along the vein. The auriferous quartz above is then stoped out, and conveyed in cars through the tunnel to its mouth, and thence to the mill.

Where, however, the character of the ground does not admit of this mode of exploitation, or where it becomes

desirable to reach deeper levels than can be obtained by such a tunnel, shafts are sunk; either vertically, to intersect the vein at a given depth, or in an inclined direction from the outcrop with the dip of the vein. Drifts or levels are then extended at proper depths in each direction from the shaft, dividing the ground into a series of vertical "lifts" or "levels," as they are called, the heights of which between the drifts varies from thirty or forty to one hundred feet. The ore in each "level" is then stoped out, and falling into the drift below, is conveyed to the shaft, through which it is hoisted to the surface. The machinery and gearing used for hoisting, pumping, and handling the ore and waste rock are pretty much the same in kind the world over. For raising water, the Cornish pump is, perhaps, more extensively used at present than any other. In some instances a compact, double-acting steam force-pump is employed instead, and being placed at the bottom of the mine, is fed with steam brought down in a pipe from the boilers above; and which, having done its work, is discharged into an exhaust-pipe and reconducted to the surface. The ore is not, as a general thing, subjected to any further breaking than that incidental to its extraction until it reaches the floor of the mill. It usually, however, undergoes a kind of rough sorting, whereby such portions as are known to be worthless are rejected; and where the veins vary greatly in richness, considerable portions of ore, obviously of a very low grade, are often left standing in the mine. Upon reaching the floor of the mill, the ore is broken to a size suitable for the stamps, either by hand, or, more generally of late, by being passed between the jaws of powerful crushers or rock-breakers.

A MODERN QUARTZ MILL,

Consists of the stamps, with their necessary accompaniments for crushing and pulverizing the ore, together with the additional arrangements, of whatever kind, below the stamps for catching and saving the gold thus set free from the gangue.

The stamp is a long, vertical iron stem, moving in guides, and furnished at the bottom with a heavy iron head. It is lifted vertically by machinery, and in falling, crushes by its weight and the momentum it acquires the rock placed in an iron trough beneath.

The California stamp, in its most recent and approved form, consists of four distinct parts, viz: the stem, the head, the shoe, and the tappet. The stem is a smooth, wrought-iron cylinder, from two and a half to three inches in diameter, and generally twelve feet long. The ends are turned with a slight conical taper for a few inches, in order that they may easily and strongly wedge themselves into the corresponding socket in the head, either end being fitted to connect with the latter.

The stamp-head is a cylinder of cast iron, usually eight inches in diameter, and from twelve to eighteen inches in length. Each end is supplied with a socket, or hole; the one to receive the stem, and the other and larger, the neck of the shoe. Each end of the stamp-head is strengthened by a thick band of wrought iron, driven on while hot, and shrunk to its place.

The shoe is a shorter cylinder of cast iron, generally of the same diameter as the stamp-head, and from four to six inches thick, being so formed that it can be easily attached to or detached from the latter; its removal being necessary when too much worn for further service.

The stamp is lifted by a cam, usually double armed, though sometimes single, fixed upon a revolving horizontal shaft, and working close by the side of the stem, against the flat under surface of the tappet. It is curved in such a way that the horizontal surface of the bottom of the tappet, at the point of contact between the two, is always tangent to the face of the cam at any instant during the rise of the stamp. The stem is kept in proper position by two guides, six or seven feet apart, the one above the other, between which are the cam, shaft, and the tappets. A result of this form and arrangement of the stamp is, that the cam, in lift-

ing it, also imparts to it a rotary motion, which, continuing while the stamp is falling, increases somewhat by its grinding tendency the crushing effect of the blow. But the great advantage of this rotary motion is, that the constant change of position produces a uniform wear of the shoes and dies, which it would be difficult to secure by any other means.

The weight of the stamp complete varies from five hundred to nine hundred pounds, and the height of fall from eight inches to a foot. The speed at which they are driven is generally about sixty blows each per minute. Each stamp can crush from one to three tons of rock in twenty-four hours, according to the fineness of the crushing and the character of the rock.

The number of stamps in a mill varies of course with the amount of work to be done, ranging all the way from three or four to one hundred and twenty, the average number being about fifteen or twenty. The stamps are arranged in what are called "batteries," each battery consisting usually of five stamps, working together in a separate cast-iron box, or mortar, several batteries, where there are so many, being driven by the same cam-shaft.

The mortar is a heavy rectangular cast-iron box, in which the stamps play and the ore is crushed. Its weight varies according to the number and size of the stamps, four or five stamps of ordinary size requiring one weighing from two thousand to three thousand five hundred pounds. Its interior dimensions, at the bottom, are such as to have but an inch or two of clear space between the stamp-heads and its sides, which are from three to five feet high. There is a longitudinal opening, three or four inches wide, in the back side, protected by a vertical apron, and running the whole length of the mortar, through which the broken ore is fed. In the bottom of the mortar, on the inside, are cast cavities for the reception of the dies upon which the stamps fall. The dies are also of cast-iron, one for each stamp. The lower part of the die, which fits into the cavity in the mortar, may be cylindrical or rectangular, the upper por-

tion is cylindrical, projecting from three to five inches above the bottom of the mortar, and has generally the same diameter as the shoe. In the front side of the mortar, with its lower lip at a proper height, from two to four inches above the tops of the dies, is the discharge opening, from a foot to twenty inches in vertical width, and running the whole length of the mortar. The latter rests upon blocks, the best form of which, in ordinary ground, consists of sticks of heavy timber, from ten to fourteen feet in length, and from two feet to thirty inches square, according to the size of the mortar and the weight of the stamps. These blocks are set in couples vertically imbedded in the ground, to a depth of from five to eight feet, two of them being used to support a single mortar. Their tops are brought as nearly to the same level as possible in setting them, and are then planed true and level. And, as it is important that the contact between the mortar and the blocks should be close and uniform, the bottom of the former is also planed true before it leaves the shop. The mortar is then placed upon the blocks and strongly bolted to them. In the discharge opening, already noticed, is fitted the screen-frame, a rectangular frame of wood, to which is fastened the screen. The latter consists of a strip of sheet-iron perforated with small holes, through which the discharge from the batteries takes place. Sometimes wire cloth is used for this purpose, but the punched sheet-iron screens are generally preferred. The size of the holes varies considerably with the fineness of the crushing required. The punched screen most in use, known as No. 6, has holes about .027 inch in diameter, and presents about 195 holes to the square inch of surface. A constant stream of water is introduced into the battery, which, with the violent agitation produced by the motion of the stamps, carries the pulverized ore through the screens out of the battery as fast as it reaches the requisite fineness. The broken ore is usually fed to the batteries by hand, one man being able to tend or feed three or four batteries. It might prove economical to

provide the batteries with a self-feeding arrangement—an improvement rarely attempted yet in California, through practiced in Australia and Europe.

The arrangements for extracting and saving the gold from the crushed ore, though varying largely in their details, have certain features always in common, chief among which is the amalgamation of the gold by means of mercury. The crushed ore and water, or the "pulp," as it is called, is led from the batteries through shallow, descending sluices, passing in its way whatever contrivances may be there adopted for saving the gold, being finally discharged as "tailings" from the lower side of the mill. These sluices are from eight to sixteen inches in width, and two or three inches deep, and have an inclination or grade dependent on the degree of fineness of the crushing, the quantity of pulp they are intended to convey, the means employed for saving the gold, etc. There are in general use two prominent modes of amalgamation—the Grass Valley system, so called from its general use in the mills of Grass Valley, and the system of amalgamation in battery.

GRASS VALLEY SYSTEM OF AMALGAMATION.

By this plan no mercury is placed in the batteries, the only portion of gold caught there being such as is too coarse to pass the holes of the screen. Of this coarse gold there is, however, always a notable proportion in the Grass Valley ores. In the practice of this method, the bottoms of the sluices are covered with coarse woollen blankets, woven for the purpose, over which the pulp flows. These blankets are spread smoothly, and made to overlap each other in such a way as to prevent the pulp from getting beneath them. As the latter flows over them, the heavier particles, which always keep nearest the bottom of the shallow stream, are caught in the meshes of the coarse fabric and there retained, while the lighter portions pass on with the current. But, as the nap of the blankets soon become filled with sand,

which, if unremoved, would soon impair, and if long continued destroy their efficiency, it is necessary to frequently remove and wash them, after which they are replaced. For this reason the sluices leading from the batteries are either made double, or three are used for two batteries, so that the pulp from either may be turned into the middle sluice, while the blankets of its own sluice are being washed—an operation that requires to be performed about once every fifteen or twenty minutes. For the purpose of washing, the blankets are placed in a large tub or vat filled with water, where they are thoroughly rinsed, the auriferous sand falling to the bottom. When the blankets have been washed and replaced, the pulp is again turned on, and those of another sluice are subjected to the same operation. The sluices below the blankets are frequently lined with amalgamated copper plates, or provided with mercurial riffles, having also in some cases the pulp conveyed over shaking tables, or subjected to other mechanical treatment, for saving the finer gold before it is finally discharged. All of these contrivances catch some gold, though most of the latter saved below the batteries is caught upon the blankets. The blanket washings are generally rich in gold, and also in metallic sulphurets, when the latter are present in the ore. They are next subjected to amalgamation in order to extract the free gold which they contain, and the sulphurets are afterwards either suffered to escape with the tailings, or are saved and ground with mercury in iron pans, or treated by Plattner's chlorination process. The amalgamation of the blanket washings is sometimes effected by grinding the whole at once in pans with mercury, but more frequently by passing them through Attwood's amalgamator. This machine is used in connection with a short sluice lined with amalgamated copper plates, arranged so as to form a series of little troughs or riffles containing mercury. At the head of this sluice are two or three horizontal semi-cylindrical troughs, of six or eight inches radius, placed parallel to each other transversely across the bottom of the sluice, and

partly filled with mercury. The blanket washings are placed in a box or hopper above, and being slowly washed down, are carried over these troughs and the copper plates and riffles below, by a small stream of warm water, a moderate increase of temperature being found to favor the amalgamation. The mercury in these troughs, together with the sand as it passes over them, is kept in a state of constant and brisk agitation by a wooden cylinder revolving in a direction opposite to that of the current, and thickly set with thin blades of iron which dip into the mercury and nearly reach the bottom of the trough.

AMALGAMATION IN BATTERY.

Frequently, when the gold in the ore is fine, and sometimes also when it is coarse, the plan of battery amalgamation is preferred. By this mode mercury is introduced into the battery, a small quantity being sprinkled in upon the feed side at intervals of from half an hour to two hours, as may be needed—the quantity of mercury required in the battery varying with the richness of the ore and the fineness of the gold; the average amount being about an ounce of mercury for every ounce of gold obtainable from the ore. If the gold be very fine, more is needed—in practice, the quantity being judged of by the appearance and consistence of the amalgam formed. The amalgam in the battery should be too hard to be readily impressible with the finger, and yet not so dry as to become brittle, which might cause it to break up and be thrown out in little pellets through the screen. A small portion of the mercury is thrown out, which, with the gold it catches on its way, forms a little ridge of amalgam on the copper plate, generally placed under the lip of the mortar outside the battery. This amalgam should be of such a consistence that an impression can be made upon it with the finger, and yet not too easily. If the amalgam becomes too soft, no more mercury is added till it regains its normal condition; and, on the other hand,

if it becomes too dry and hard, the supply is increased until it is brought to the proper consistence.

For the purpose of collecting the amalgam formed in the batteries, the latter are usually partly lined with plates of sheet copper. Upon the surface of these plates the amalgam collects, not in a layer of uniform thickness, but in irregular bunches and little ridges, the position and thickness of which are mainly dependent upon the "swash" produced in the battery by the order in which the stamps fall. The curious effects of this "swash," in determining the distribution of the amalgam upon these plates, is a point worthy of more attention, perhaps, than it has yet received.

Below the batteries come the sluices, with their copper plates, riffles, etc., for saving the gold escaping from the former; these arrangements, differing generally but little from such as are used in the Grass Valley system; the blankets and their accompaniments, however, being but rarely used where amalgamation in battery is practiced.

Various opinions are entertained by metallurgists and millmen as to the efficiency and economy of battery amalgamation; some, who have practiced it for years still adhering to it, satisfied with their experience; and, while it is no doubt open to certain objections, it is preferable to all others. Quartz mills usually run steadily both day and night; where, however, battery amalgamation is practiced it becomes necessary now and then to stop the mill for a "clean-up"—that is, to collect the amalgam, which has accumulated in the batteries and on the copper plates. Sometimes the whole mill is stopped for this purpose, while at others, in order to save time, a single battery only is stopped and cleaned up, and then another, and so on, till the whole are thus gone through with. A "run" in a quartz mill varies, according to circumstances, from twenty to sixty days. The amalgam obtained is strained and retorted in the manner already described.

For the purpose of extracting free gold from quartz, the ore is rarely reduced to any finer state of pulverization than

is attained by crushing under the stamps with the screens, already described. But when auriferous sulphurets are present, sufficiently rich in gold to make its extraction an object, they are frequently subjected to a further process of pulverization and amalgamation. This is effected by grinding them in a flow of water and mercury in an arastra, Chili mill, or in some of the many patent cast-iron pans or grinding mills of recent invention. These pans having first been introduced as a substitute for the German barrel in working the silver ores of Nevada, where they still continue in use, were afterwards employed also for working the gold ores in this State; and, although they may in certain cases be used here to advantage, especially in treating such mercurial residues as may be collected from the various parts of a quartz mill; they are nevertheless gradually going out of use, many mill-men having discarded them altogether. For a description of these pans, and further information touching the extraction of gold from the sulphureted ores, Kustel's work on Concentration and Chlorination may be consulted to advantage.

TRoubles AND MISTAKES FROM THE START.

Having thus described the quartz lodes, and the machines and processes employed in working the ores therefrom, a few words will next be said about this business as heretofore prosecuted in California. Quartz mining commenced in this State, at Grass Valley, as early as 1851. A number of ledges having that year been opened, several hundred tons of ore taken out, and a small stamp mill put up at that place. Later in the same year a similar mill was put up near Jamestown, in Tuolumne County; the much larger and better appointed mill erected on the Fremont Estate, in Mariposa County, having been commenced in 1852, and completed the following year. After this, and during the next five or six years, these establishments were multiplied quite rapidly; Grass Valley, however, keeping the lead. Owing to a variety of causes, principally inexperience on the part of our quartz

miners and metallurgists, many of these early enterprises proved failures, and a large proportion of the mills throughout the State were finally shut down. Besides the errors arising from inexperience many other blunders were committed in the conduct of this business, some of them being so gross and inexcusable as to almost savor of criminality.

OLD-TIME ERRORS.

Of the mistakes and abuses incident to this branch of mining, J. Ross Browne, in his report to the Secretary of the Treasury, wrote as follows eighteen years ago :

“ Many of those old enterprises have not yet become, and never will become profitable; but of the quartz mills built within the last four or five years, the successful proportion is much larger than before 1860. No business offers greater facilities to ignorance and folly for losing money; and unfortunately, most of those who engaged in it had no experience and were led by their presumption into gross blunders in both mining and milling.

The greatest common blunder in quartz mining, and the most common error in early times as well as in our own day, has been that of erecting a mill before the vein was well opened and its capacity to yield a large supply of good rock established. The commission of this blunder is proof conclusive of the utter incompetency of its author to have charge of any important mining enterprise. If there were any possibility that it should in some cases lead to considerable profit, there might be an excuse for it, but there is none. It never pays. All the chances, including that of utter failure, are against it.

The next blunder was that the difference between a pocket vein and a charge vein was not understood, and the existence of rich specimens was considered proof of the high value of a mine, whereas among experienced quartz miners it excites their suspicion and distrust. Nine-tenths of the lodes which yield rich specimens do not pay for milling.

West Point, in Calaveras, and Bald Mountain, in Tuolumne, the richest pocket districts of the State, are not to be compared for yield with Sutter Creek or the Sierra Buttes, where there is scarcely a passable specimen in a thousand tons.

The next error was that nothing was known of pay chimneys, and if good quartz was found in one place, it was presumed that the whole mine was of the same quality. In some cases the pay chimney was near the end of a claim, into which it dipped not far from the surface, leaving the mill without rock. In other cases the miner had his pay chimney in his own claim, but he did not know enough to follow it, and he worked straight down into barren rock, while there was an abundant supply of good quartz higher up.

Another error was that of sinking when nothing was found at the surface; a policy that may do in mining for other metals, but is very risky in gold. If the croppings are barren along a considerable distance, deep sinkings will rarely pay; but if the vein does not crop out, the only way to examine it may be by a shaft.

Much rock has been crushed without examination and without any proper selection.

In the mortars it is a common mistake to use too much quicksilver and too much water.

It has not been customary to make assays regularly of the tailings, so as to know what was passing off.

The mine owners, in a large proportion of the cases, have not resided at the mines, and have not made a study of the business; and no occupation requires personal supervision and thorough knowledge on the part of the owner more than mining.

These blunders are gradually being corrected, and if they were not still quite common the quartz mines of California would yield nearly twice as much as they do. The business will never be established upon a proper basis until the superintendents as a class are well-educated chemists and mining and mechanical engineers, and the mine owners frequent visitors, if not regular residents at the mines."

While some of the errors here pointed out continue to be repeated, we think it may justly be claimed that the most of them have of late come to be avoided, especially that of building mills before the capacity of the mines had been sufficiently shown to warrant their erection. Neither do we now conclude that because a little good ore is found in a vein this will constitute it a mine, nor yet are we apt at this day to start exploratory works in search of ore deposits where there is nothing found on the surface.

MISTAKES MOST APT TO BE MADE.

The following, bearing upon this subject, we extract from a late issue of the *Tuolumne Independent*, being of the opinion that it is hardly possible to say too much in impressing upon all connected with or interested in mining operations these conservative views and wholesome precautions:

“Mining is naturally uncertain, and mineral veins are liable to take strange freaks and not to follow any law. Each one is a law unto itself, and a separate problem to work out, involving the questions of determining first the extent of the ore body, and then determining the best means to successfully treat the ore. Miners are liable to exaggerate the extent of their ore bodies, and, as a rule, are inclined to spend too much on surface works; and it is nothing unusual in this county to see a mill built before the miner has found out that he has a mine. Mining and milling ores is a trade, and requires study and practice, as well as a natural adaptability and liking for the pursuit. Against the natural uncertainty of mining can be placed the fact that while the risks are great the chances of profits are likewise great. No other business shows such chances for profits or for loss.

The chief cause of mining failures is lack of proper knowledge on the part of the men who manage mines. Men who have no proper qualifications for the craft are made superintendents of mines, when the expenditure of large sums is

left in their hands in the loosest way possible, and these fellows often *work the company* instead of the *mine*. Intrusting large sums of money to these men is liable to turn their heads, and they gradually grow careless how they spend the money, as long as they get their share.

Now, we take it, that a man to direct a mine successfully needs first to have good business capacity, and, in addition to this, he must understand mining and milling ores. Of course he need not be a brawny fellow who can strike a drill, or pick and shovel; he needs only to know how it should be done and how to direct it, and see it done properly. No other business requires so much capital, and no business is so much done by proxy. If the people who work mines would have more personal supervision of their mines there would be fewer failures for them—they would be able to check the blunders and extravagance of their managers. Mining is expensive in all its branches, and requires careful, skillful men to direct it profitably.

People generally make the mistake of expecting too much out of a mine, and are inclined to be lavish with their money when the mine pays, thinking their bonanza will never peter out, and they do not lay up anything for a rainy day, so that when the lead gives out there is no reserve fund for dead work or prospecting, and then failure often ensues.

It happens often that miners underestimate the cost of opening and developing their mines, and after they have used all their money they try to work on credit, trusting to luck to get money enough out of the mine to pay up, and very often leaving their creditors in the lurch. This kind of mining will not do—we have had too much of it in this county—and we do not see why a miner should not pay his men and his grocer's bills, just the same as a farmer or any one else does; and further, when he does not see his way clear to do so, he ought to stop work. It is no unusual thing for a miner here to shut down and leave miners and everybody else unpaid, because the *mine don't pay*. This is not right, and this thing of men trying to mine on their

good looks must stop. A '*wind engine*' is a poor one for a mine, as some of the miners of this district can testify. 'Money makes the mare go.' She need not go 2.40, but she can go as fast as she pays. There is no law compelling a man to work a mine when he cannot pay his bills, and we do not know why so many think they have to mine on credit."

MELVILLE ATWOOD ON MILLING AURIFEROUS QUARTZ—THE TRIBUTE SYSTEM OF MINING.

Having thus pointed out some of the more glaring errors of the past, and duly cautioned the miner against their recurrence, it may be pertinent to next remark upon some of the methods in use in the treatment of gold-bearing quartz, both here and elsewhere, quoting a few of the recognized authorities on the subject.

Melville Atwood, who has had a very extended and valuable experience in this business, remarks as follows:

"I would advise, for low grade rock, stamping it as coarse as such a machine as the "Frue," or other improved concentrator can treat to advantage. The size of the aperture in the screens should gradually increase, and be the largest in the upper part, which would in a great measure prevent what is termed "dead stamping," and, at the same time, add greatly to the duty of the stamps. Screens having twelve holes to the linear inch in the bottom and ten in the upper part, are not too coarse for low grade rock, and in using them, stamp-heads weighing eight cwts. would reduce on an average about four tons per head in the twenty-four hours, and those of six cwt. three tons, and any trifling loss of free gold will amply be made up by what is saved in the sulphurets—so that a "*ten-stamp mill*," with heads weighing eight cwt., can be made to work to advantage forty tons of rock per day. The fineness of the stamping, however, is in part regulated by the position of the screen, that is, its horizontal distance from the stamp-head and the vertical height

of the bottom of the screen above the level of the die. For example, the finest work is done by splash-stamping, that is, without using any screens, and allowing the pulp to be discharged over the front side of the mortar, which is purposely made lower than the back or feed part.

The Port Philip Company, in Australia, use them with ten holes to the linear inch. Steel wire-cloth is the best, and lasts better than any other.

Some years ago, in a communication to the State Geological Society on the subject, I recommended fine stamping for low grade rock containing a large proportion of sulphurets; but recent improvements in concentrators and a closer examination of the condition of the gold in the iron pyrites, of which I find so large a proportion is in thin films, and which, with a rapid flow of water, would be carried away, and a greater part of it lost, have altered my opinion on this point.

It is not generally known, but nevertheless, from numerous and very careful tests, it is proved that in fine stamping, when the speed of the stamps is above seventy blows per minute, that the loss of gold, when blankets or rawhides are used, is much greater than at a speed of fifty blows per minute, though I am not aware that any tests have been made when the amalgamation was done in the battery. The system of amalgamation in the batteries, however, I have always considered a mistake, and as entailing a great loss of gold, particularly so when the rock contains a large proportion of sulphurets; besides, if precautions are not taken, a low degree of temperature will render the amalgamated silver plates nearly useless. To understand this correctly, let the millman put two or three barrowfuls of rock, very rich in sulphurets, through the stamps, and then watch the effect on the amalgamated plate, and at the same time collect some of the pulp after passing over the plates, and have it carefully tested, and he will then better understand why I prefer the blanket system.

Professor W. W. Smyth, in one of his lectures on gold,

with respect to stamping, says: "Take a large hammer and gently crack a nut with it, and you have an illustration of what a stamp had ought to do—it ought, if possible, to crack the enveloping shell of stone, and set free the kernel of metallic mineral unbroken."

Or, for instance, take a piece of veinstone from the Bodie district, one-half of it pound very fine, using a grinding action with the pestle, then wash out the gold in a batea or horn spoon, and you will find that a large proportion of the gold will float away, in spite of every care, even using ammonia to destroy the grease on the ends of the fingers.

Then take the other half, pound it very coarsely, and in washing out the gold you will see very little float, and two or three turns of the batea will bring all the gold into the center.

In the blanket system, where improved concentrators are used, after the pulp has passed over the blankets, only two lengths of trays of about four feet each, and two sets to each five stamps, are required. They should be so arranged that the inclination can be altered, say from 3° to 5° , to suit the stuff being treated.

The trays should be about sixteen inches wide, and the fall from the battery box to the head tray the same as from one tray to another, about four inches, with a board placed across the end that the fall of the water or pulp will be so broken as to strike the blanket in the tray below nearly at right angles. The blankets should be in three-foot lengths, and made of coarse wool with a long nap. The double sets of trays are for the convenience of changing and washing the blankets. The blanket washings can be passed through a simple machine like that described in Phillips' Metallurgy (see page 185), and the tailings from it ground with the coarse concentrations in a Chilian mill.

It is not so much the length of the blankets that separates the gold from the gangue, but the fall, or jump, onto them.

Where the mill has a limited supply of water, and they do not like to go to the expense of a number of concentrators, a coarse concentration may be made with a "Tye Buddle," the plans and directions for the use of which will be found in "Phillips' Metallurgy of Gold and Silver," page 187.

The concentrations from the "Tye" can be passed over the "Frue," one of which would then be sufficient for a large mill, though I am not prepared to say by such means they can work as closely as by using the "Frue" alone.

In case the mill is not situated at a very great altitude, where the frost might interfere with this working, amalgamated plates in three feet lengths and two feet deep, on a fixed frame at an angle of about 3° , to which a slow lateral movement backward and forward of one foot, together with a slight shake is given, in the same direction with a sprinkling of clean water from a perforated pipe falling on the upper part above where the pulp strikes, might be placed with advantage between the blankets and concentrators. The concentrations should be sifted through a seive having 80 holes to the linear inch, and any particles that were not fine enough should be ground in a Chilian mill, the same as described by Mr. Latta, but without using the mercury, and afterwards charged into wooden barrels for amalgamation; but, before charging, the sulphurets should be soaked in water, to free them from all decomposition. I feel confident that larger results will be obtained by thus treating the raw ore than if it was roasted.

The great difference between a wooden surface and a metal one in amalgamation can easily be shown by washing out, say, about one dwt. of Bodie or Grass Valley gold in a batea and then adding, with a dropping bottle, just sufficient mercury for it to amalgamate with, too much or too little will lengthen the result, but if the proper quantity be used by rubbing it with the finger in the center of the bowl it will amalgamate rapidly in less than a minute. Try the same experiment with an iron pan, and you will find how much longer it takes to get the same result. I would

strongly recommend any mine adventurer, before erecting any quartz mill, or adopting any particular process, to have some twenty or thirty tons of the rock or vein-stone stamped, and to save, during that operation, a fair sample of the battery pulp from it, which should be carefully concentrated in a batea, or any other utensil used for washing on a small scale. The condition and quantity of the gold, and other ores and minerals, should be tested and examined. The percentage of the sulphurets can also be roughly estimated at the same time, and all afterwards compared with the gross results from stamping.

Mr. Edward Booth, the analytical chemist on Sutter street, has kindly furnished me with directions for making a simple test for tellurium, in case telluric gold is suspected to be mixed with the sulphurets. It is as follows:

“Place in a test tube, or other vessel capable of resisting the action of acids, a small amount of the suspected material, which has been separated as thoroughly as possible from the accompanying gangue. Add enough sulphuric acid to well cover the sample and heat to boiling. If tellurium is present the liquid becomes colored a clear purplish-red.”

I can only now add that had I years ago acted upon what I now suggest to others, I would have saved large sums of money for my partners and self.

As bearing on the use of the PAN SYSTEM it may be asked, what is the difference between the gold and sulphurets in the Mammoth lode, Mono Co., and in the Sierra Buttes lode? Is not the gold in the latter much more difficult to save, and would not the Comstock soda, salt and pan system, if introduced at the Sierra Buttes mine soon close it up like the former? For my own part, I firmly believe that if the same pan system were used in the Victoria district, Australia, all the mines using it would soon cease to pay dividends; and also, if the Idaho mines at Grass Valley, were to try it that their dividends would soon be reduced one-half.

If the correct number of tons of mercury, soda, salt and

"other chemicals," as they are called, that have been sent to the Mono County mills were published, I am afraid it would appear to be very large.

It might be argued that the chemicals used in the Bodie mills were for the extraction of the silver from the ores; in that case it would be exceedingly interesting to ascertain the expense, and see if it did not, as some think, cost two dollars in coin for every dollar in silver so obtained.

THE TRIBUTE SYSTEM

Has been introduced in Australia with great success. Too much can hardly be said in favor of such a system, as it places the hard working and intelligent miner on a much more respectable and independent footing, and though he, in a measure, shares the risks, but only so far as his judgment guides him, he gets the benefit of any discovery he may make; it also encourages him to study the peculiarities of the lode and enclosing rocks, besides which, by that system, all were jointly interested in the welfare of the mine. Many of the mines now idle in this State could be worked profitably under the system, particularly in the Bodie district.

In the Port Phillip report it says: "The number of tributes has averaged about two hundred during the year, which shows no decrease when compared with the preceding year. The tribute system has been further extended by an arrangement with the tributers to drive the levels in the ground let to them, the company assisting them with driving timber and rails, and making an allowance per fathom until the yield reaches six pennyweights per ton, when no further assistance is given; the company receiving half the gold obtained and deducting from the allowance the cost of tramming; by this means a large amount of driving is done at a comparatively small cost."

The number of tons of quartz stamped on tributer's account for the year was forty-eight thousand one hundred and eighty-four tons. The average yield of the entire quan-

tity raised was five pennyweights, five and one-half grains per ton (say five dollars).

| | |
|--------------------------|----------------|
| Total receipts..... | £32,364 14s 7d |
| Expenditure..... | 27,310 10s 7d |
| Leaving a profit of..... | £5,054 4s 0d |

In conclusion, so thoroughly am I convinced of the great benefits that would result to this State by a more general introduction of the tribute system in an extended form, both to the placer as well as vein mining, that I wish particularly to call your attention to it, so that through the influence of the Bureau and press, the subject may be brought in a proper light before the owners of mines or claims. A fair tribute will secure the *muscle* of the working miner, who, in too many cases, understands better than the superintendent (generally a man of business) how to conduct trials for ore, and afterward to develop them. The *muscle* of the skilled miner is in every respect better than foreign capital.

There is no need of the hard working miner to leave this healthy climate in search of employment, if those who own mines that are now idle, would let the fact be known through the press, and at the same time offer a fair tribute for working them.

MACHINERY, PROCESSES, ETC.

Under the above heading, the various mechanisms, implements, agencies and processes employed in the business of mining for the precious metals, both as regards placer and vein operations, will be noted and commented upon. In this chapter will be found a further description of the machines and methods used in the reduction of auriferous ores; also, articles descriptive of the Frue Concentrator; the Ingersoll Power Drill; the various kinds of quartz crushers, aside from the stamp mill, most in use; the different styles of rock breakers and ore feeders; the employment of giant powder and other high explosives in blowing up gravel banks, and, in short, every thing directly connected with and designed to aid practical mining operations.

CONCENTRATING THE SULPHURETED ORES.

We come now to the consideration of a subject of the greatest importance in connection with the business of working the auriferous ores of California; the concentration and saving of the sulphurets with which a large proportion of these ores is heavily charged. For many years, at first, no attempts were made by our quartz miners to save these sulphurets, whereby heavy losses were sustained and much consequent disappointment caused. The millman and miner could get big returns from the assayer, but were unable to work out corresponding results in the battery, and not until concentration began to be practiced was this trouble overcome. Nor was this end reached at once, nor yet for a number of years, at first owing to the want of a more perfect machine for effecting this purpose. Finally, the

FRUE VANNER, OR CONCENTRATOR,

Entering the field, supplied this deficiency. This machine, while it introduced the true method of concentration at the

start, was, still, in some minor particulars, open to improvement. Through years of careful experimenting, these defects have been so remedied as to bring this machine to a state of the highest efficiency if not of absolute completeness.

W. B. Frue, its inventor, while engaged in treating the ores of the Silver Islet mine, on Lake Superior, found that by reason of their extreme low grade, their more thorough concentration would have to be effected before they could be worked with much profit. With a view to accomplishing that object, he engaged in a series of practical trials with the machines then in use. Out of these trials was evolved the side-shaking traveling belt, the most distinctive and characteristic feature of the primitive Frue Concentrator, which has, however, since been much improved upon.

Notwithstanding the Frue Vanner had its inception elsewhere, the machine, as it came from the hands of the original designer, has since been so improved upon by Messrs. Adams & Carter, agents on this coast, as to constitute it virtually a California invention. This firm, who had previously had a large experience in the treatment of refractory ores, discovering that the Frue embodied the true principle of concentration, after obtaining the agency for the machine, secured a number of other patents, each noted for some peculiarity or excellence, and combining the whole, produced this, the most simple and perfect Concentrator in existence.

The Silver Islet Company, having put up a fifty-stamp mill furnished with twenty-four of these Vanners, this mill paid the cost of its erection in about four months' run—five-ounce silver bearing ore having been worked here with profit. The great step in advance of other concentrators made by the Vanner, was the treatment of a stamp mill pulp at one cheap operation, with the production of absolutely clean concentrations and with surprisingly low loss of value. A material which in Germany would be divided into at least three classes and treated on at least six machines,

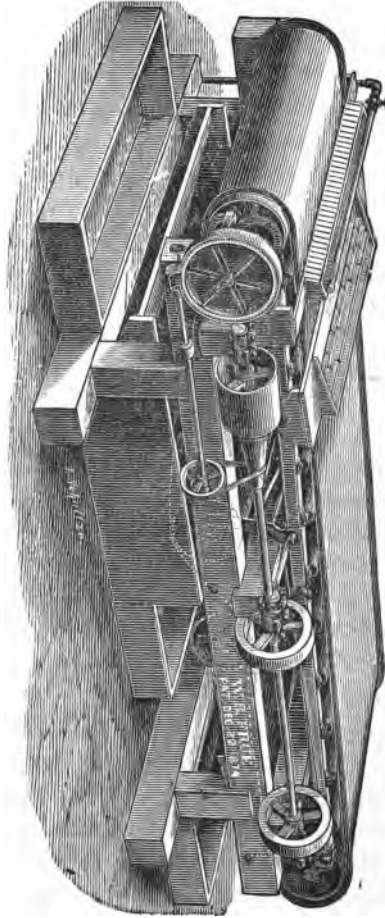
was treated at once on a single machine, and cleaner concentrations produced than was effected in that country from a number of combined treatments.

With labor, fuel, transportation and smelting as high as they are in the United States, rapid automatic treatment is a necessity for tailings or low grade ore. The only objections that one ever hears urged by men of experience against the Frue Vanner are, that it is "slow," and needs exact "adjustment;" and new concentrators keep coming out which are both "fast" and "not delicate," and can, therefore, it is said, be run by a child. But these troubles pertain to and are inherent in the work to be done, and cannot be charged to this or any other machine. For finely crushed ore rapid treatment and close work are utterly incompatible, as every slime dresser knows; as to adjustment, the very fact that this Vanner is automatic and continuous, implies that it must be adjusted right to its work, and kept under the same conditions. To illustrate: watch a man tending a single Vanner in a mill where engine speed or water supply is irregular. Every change of speed of engine or volume of water needs a corresponding change of machine, either in water or belt travel. Next step into a mill with sixteen of these Vanners running like a piece of clockwork, and you see one man keeping a general eye over them while handling the concentrations produced. The two cases answer all objections as to complication and difficulty of adjustment. In the first, one man is driven wild watching a single machine; in the second case one man has an easy job looking at sixteen machines, which are treating eighty to one hundred tons of ore every day.

In the course of events the Frue Company instituted a suit against the inventor of the Embry machine, to restrain him from infringing their patent, which resulted in their becoming themselves the owners of this invention, which included an endless belt concentrator, with certain peculiarities of water distribution and construction. They also at different times purchased several other patents

having a general bearing on the question of endless traveling shaking belt machines, thereby securing by patents all that is peculiar and essential in this class of machinery.

FRUE VANNER OR ORE CONCENTRATOR.

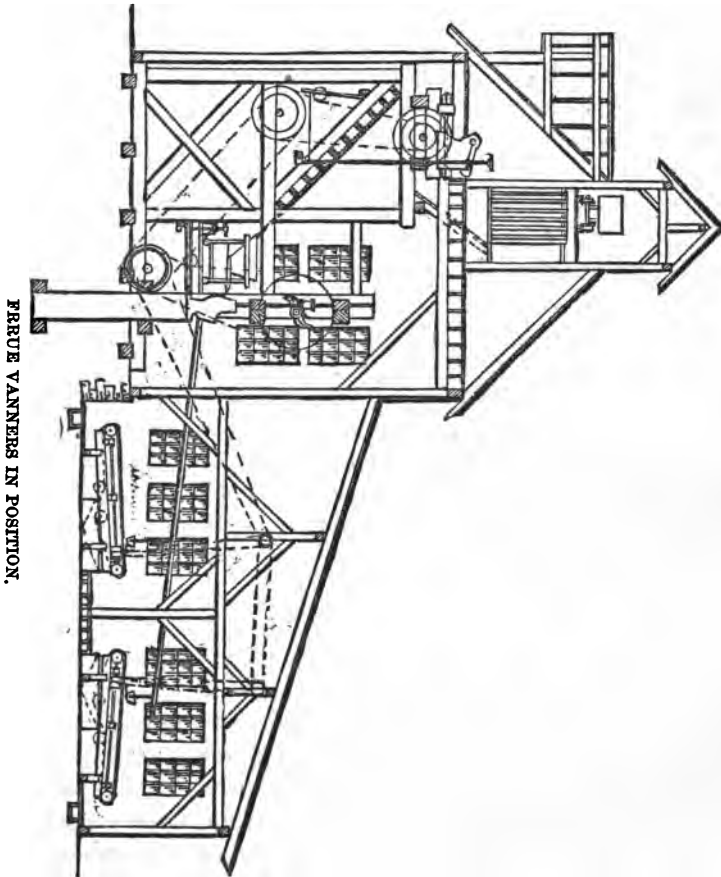


As tending to establish the simplicity, cheapness, effectiveness, and such other properties as should distinguish a machine of this kind, the Frue Company have any number of testimonials from millmen all over the country. That

these testimonials are well deserved, we can certify of our own personal observation, at least in so far as California is concerned. During a trip recently made through the quartz mining districts of this State, we visited nearly all the larger mills now running. Almost everywhere we found the Frue Vanner in use; and, on enquiry as to its merits, received but one answer: it was doing good and entirely satisfactory work, so satisfactory that nobody seemed to desire or contemplate a change. Being surprised at this apparent unanimity of opinion, we were led to inquire as to the trials made of other machines; the result of such trials, if any had been made, etc. The reply, as a general thing was, that no experimenting with other machines had been made, the Frue having rendered such good service that this had never been considered necessary. Trials of other machines where made had, in most cases, led to their abandonment and the substitution of the Frue in their place. This was our experience in visiting the mills about Grass Valley, Nevada City, and in several other quartz mining centers of the State, and knowing how many other concentrators there were in the field, all claiming merits equal or superior to the Frue, we must say the presence of the latter everywhere caused us no little surprise. Of course, this condition of things can be accounted for only in one way—the Frue Concentrator must be so unmistakably superior to all others that the latter are practically excluded from use, at least in California.

We have thought it proper to say this much, both as a matter of justice to the Frue Vanner Company and the mining public, it being to the latter a consideration of no little moment that they should, in making a selection of machinery, whatever the kind, endeavor to choose the very best. In this connection it is pertinent to state that these machines, both the original Frue and the Embrey patent, are manufactured by Messrs. Fraser & Chalmers, of Chicago, and Messrs. Adams & Carter, of San Francisco, and practical working tests are made at the works of the latter, and also at the works of the New York Ore Milling and Testing

Works, 528 West Sixteenth Street, N. Y., where concentration can be conducted in connection with gold and silver amalgamation under the same conditions as exist in regular mill working.



Full descriptive pamphlets, lists of mills using Vanners, and testimonials, with all information as to terms of sales, can be obtained from the firms above mentioned, and also from Mr. L. C. Trent, Denver agent; Mr. H. O. Reinhardt;

of Chihuahua, Mexico, or at the office of the Company, 2 Wall Street, New York.

In closing our remarks on this subject, it may be observed that the success of quartz mining in California will depend much on securing a proper concentration of the sulphurets contained in this class of ores, which, already large, is bound to increase as depth is attained in our mines. In these deposits reside our more prolific as well as our more permanent sources of mineral wealth, wherefore there should be given to this branch of the business the closest attention. On cheap and effectual ore concentration the lives of many of best mines will hereafter be dependent.

THE POWER ROCK DRILL—A MARVELOUS AND TIMELY INVENTION.

The Rock Drill, with its attendant Air Compressor, constitutes one of the most wonderful pieces of mechanism yet contrived in an age distinguished for novel and useful inventions. To say nothing of the ingenuity displayed in the construction of the drilling machine itself, this method of obtaining a puissant yet safe and docile propulsive power from an element so simple and so common, fills even the scientific mind with amazement, while to those devoid of technical knowledge it is utterly incomprehensible. The employment of common air so subjected to compression was new, not only in its conception but also in its application. Steam, though a dangerous and rebellious agent, had long before been pressed into the service of man, and the force of certain of the gases, though not much utilized as motors, was nevertheless well understood. But not until the advent of this Compressor had the vital, all-pervading atmosphere been turned to much practical account. The invention of the telegraph, the electric light, and the telephone, have justly excited the admiration and wonder of mankind, but the mechanisms we are speaking of seem calculated to cause almost as much wonder as either of these.

We have, on a preceding page of this book, spoken of the time consumed by the early drift-miners in driving the tunnels for opening up their claims; relating how these works, requiring long years for their completion, the men engaged in driving them, worn out and impoverished, being often forced to abandon them before they were finished. How different would have been the result had there been such a thing as a power drill in use at that day! What of disappointment and loss might have been averted; what of precious human life might have been saved had these time, labor and money saving machines then been available to lighten the burdens of these hardy, well deserving men! Years of toil and waiting would then have been reduced to months, and the expenditure of thousands would have been limited to hundreds of dollars. Not only so, but all other forms of mining in the prosecution of which rock excavation becomes necessary, would have been cheapened and facilitated to an almost equal extent. Incalculable would have been the accruing benefits to California could these power drills have been introduced here twenty years sooner than they were. How much their employment has advantaged certain tunnel enterprises now in progress will be noticed further on. They did, it is true, at the time of their introduction, meet with considerable opposition on the part of the workmen accustomed to hand drilling. This, however, sprung from selfish motives and was natural enough, as the amount of manual labor required for accomplishing a given amount of work was through their use to be diminished fully three-fourths.

THE INGERSOLL ROCK DRILL.

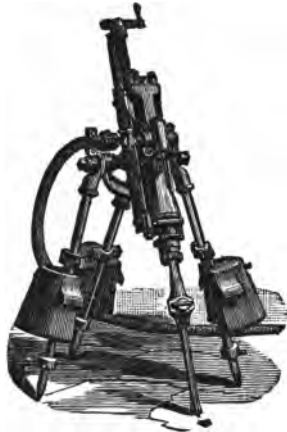
Of several different styles of these implements soliciting the patronage of the public, the Ingersoll machine seems to have come into much the largest use, both in this and in other countries. The same remark applies also to the other mechanisms and utensils manufactured by the same com-

pany, and which cover a wide range in this particular line of invention. The preference so given to the products of this company is said to be due to the following facts: First, their machines are intrinsically better than any and all others; and second, they decline to compete for that patronage which gives a preference to cheap and imperfect over solid and superior work. They turn out only the latter, a policy that fails not to win in the end, being duly appreciated by the best class of customers.

As nearly as we can learn, the first Ingersoll Rock Drill was invented about twenty-five years ago. Though since much improved upon, this machine, besides possessing some original features of great value, was built with such strict reference to simplicity, durability, lightness and effective drilling power, that it soon largely superseded its predecessors in the field, some of which had proved absolute failures, none having achieved more than a partial success. All the machines previously built were mounted on a framework so rigid and unwieldy that it was well nigh impossible to get it into a narrow and uneven rock excavation, the implements themselves being at the same time so ponderous that they were extremely difficult to handle.

In the Ingersoll Drill, these objectionable features having been wholly obviated, it stands now the *ne plus ultra* in this department of mechanism. If this be possible, however, the proprietors will not fail to further perfect it, as they are all the while studying and experimenting to that end. Meantime they will go on constructing their machines on the present approved plan, with the utmost care and out of the best material, selling them, as heretofore, at a reasonable profit.

The Standard "Eclipse" Rock Drill, is the name given by the company to their present perfected machine, the outgrowth of the primitive Ingersoll Drill, this latter having undergone such modifications and additions as rendered this new and more expressive name necessary.



THE STANDARD ECLIPSE ROCK DRILL.

Mounted on an adjustable tripod, and in position for surface work, stoping, etc. In this new drill the number of wearing parts has been reduced to a minimum, there being less by one half than are employed in any other machine of the kind. This arrangement, while it reduces cost of repairs, adds to the efficiency of the implement, which is now capable of performing twenty-five per cent. more work at less cost than any other drill ever made.



DRILL IN POSITION FOR HORIZONTAL WORK.

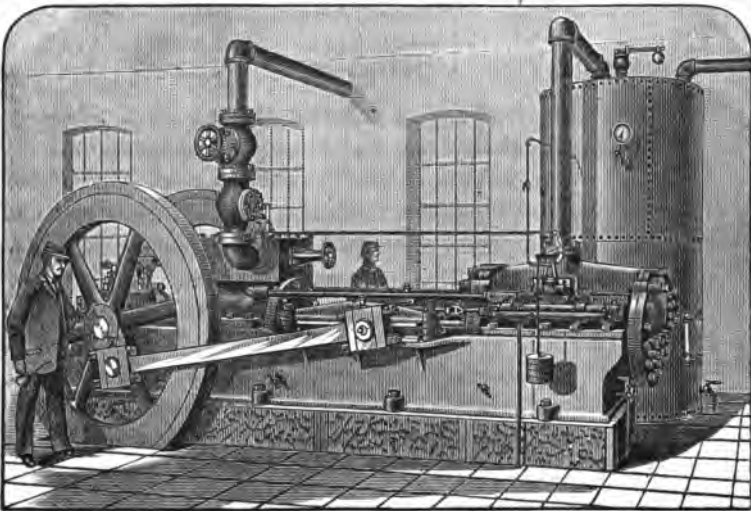
The employment of compressed air as a motor for operating rock drills, coal cutters, pumps, and other kinds of machinery underground, is a modern device, having been invented and brought into use only within the past few years. This agent, when employed for driving subterranean machinery, possesses all the essential properties of steam without the loss of power due to condensation, and without the heat and many other inconveniences attending the use of steam for propulsive purposes, more particularly where the machinery to be driven is located in confined places distant from the source of supply. It is therefore applicable to all engines that can be operated by the expansive power of steam, either at high or low pressures; and one of its principal advantages over steam is, that it can be stored and transmitted through pipe to any distance without material loss of pressure or diminution of volume; the only requisites being pipe of ample area, with tight joints and laid with the least possible number of sharp turns.

These qualities render compressed air eminently well adapted for the purpose of running rock-drifts, coal cutters, pumps, hoisting engines, and other machines used in mines, shafts, tunnels, and underground work in general, where the direct use of steam would be very inconvenient, and in most cases entirely impracticable. For this class of work particularly, compressed air has the additional advantage that, upon exhausting from the drills or other machines used, it furnishes to the workman a constant and abundant supply of pure, fresh and cool air; thus in many cases obviating the necessity of providing other and expensive means of ventilation.

The Air Compressor that goes with the Power Drill, is hardly less a novelty than the drill itself. The cut here given shows one of these machines set and at work, the one represented being known as the Ingersoll "Straight Line" Air Compressor.

It was the first of its style ever constructed, and quickly took its place as the *Standard Air Compressing Engine*. Being in every way a superior machine it is not intended to compete with the numerous poorly designed and cheaply constructed compressors now being offered.

This compressor is built on the most approved plan—i. e., medium stroke, direct strains, heavy fly wheels, slow motion, forged cross-head, steel crank and pins, phosphor bronze boxes, valves and guides, spray pump for cooling and lubrication, automatic speed and pressure regulator, adjustable cut-off valve for economical use of steam; material and workmanship first class.



THE INGERSOLL "STRAIGHT LINE" AIR COMPRESSOR.

The most essential details in the construction of the compressor are found in the patented cylindrical inlet and outlet air valves; in the quick and simple manner of adjusting the boxes or bearings for the main shaft, in the cross-head swivel block; in the pump arrangement for spraying cold water into the air cylinder for cooling the air; the arrange-

ment of valves and passages for throwing the engine off the center by air pressure; for a simple but efficient pneumatic self-regulating device for controlling the speed of the engine to conform to the consumption of air. During a temporary cessation of the consumption of air, the inlet valves are closed by the internal air pressure, while the regulator opens a passage connecting the opposite ends of the cylinder, allowing the pressure to equalize in front and back of the piston, thus releasing the engine of its load and at the same time admitting a limited supply of steam, sufficient to turn the engine over its centers and overcome friction. The compressor is perfectly automatic, and requires the attention of an engineer only to oil, and turn on and shut off steam.

ELECTRIC MINING MACHINERY.

The latest improvement in mining machinery is that of the "Wiswell Electric Ore Pulverizer and Amalgamator Combined," an engraving of which is shown herewith. It is confidently claimed by the manufacturers that this mill is capable of doing more, better and cheaper work than any others heretofore offered to the mining public. The points of superiority claimed by the company for this machine are as follows:

First, that its first cost is not one-half the cost of a stamping battery of sufficient capacity to do the same amount of work; second, it takes but half the power to run it; third, the wear and tear of the mill is not one quarter part that of a 20-stamp battery; fourth, the quality of work done by it is superior to that of the stamp mill; it makes no slimes, crushes to uniform fineness, does not flour mercury, and can be cleaned up in five minutes without stopping the mill, simply by discontinuing the feed and opening the tap-off flow; fifth, amalgamation may be carried on in the same operation with the pulverizing, by placing the mercury in the mill while grinding, and tapping off the amalgam at suitable intervals without stopping the mill or interfering with the

grinding, fresh mercury being put in to replace that drawn off in the amalgam; in this way the pulverization and amalgamation is carried on simultaneously and continuously throughout the twenty-four hours. Sixth, and chiefly, the long and earnestly sought-for application of electricity to the operation of disintegrating the ore, and accelerating the process of amalgamation, has at last, by this mill, been practically and successfully accomplished. By certain processes patented and owned by this company, a constant current of electricity, of any desired force, is passed through the pulp while grinding, resulting in the saving of from 25 to 30 per cent. more gold or silver than can possibly be accomplished without it. Extravagant as this statement may seem, it has been more than fully borne out by actual test and experiment; the average result of numerous trials with free-milling and sulphuret ores being a saving of 78½ per cent. of the gold contained in the ores, as shown by fire assay when worked with electricity, as against an average saving of 52 per cent. from precisely the same ores, when worked without electricity. The establishment of these facts is sufficient to show that this mill, with its electrical attachments, is destined to effect a complete revolution in mining.

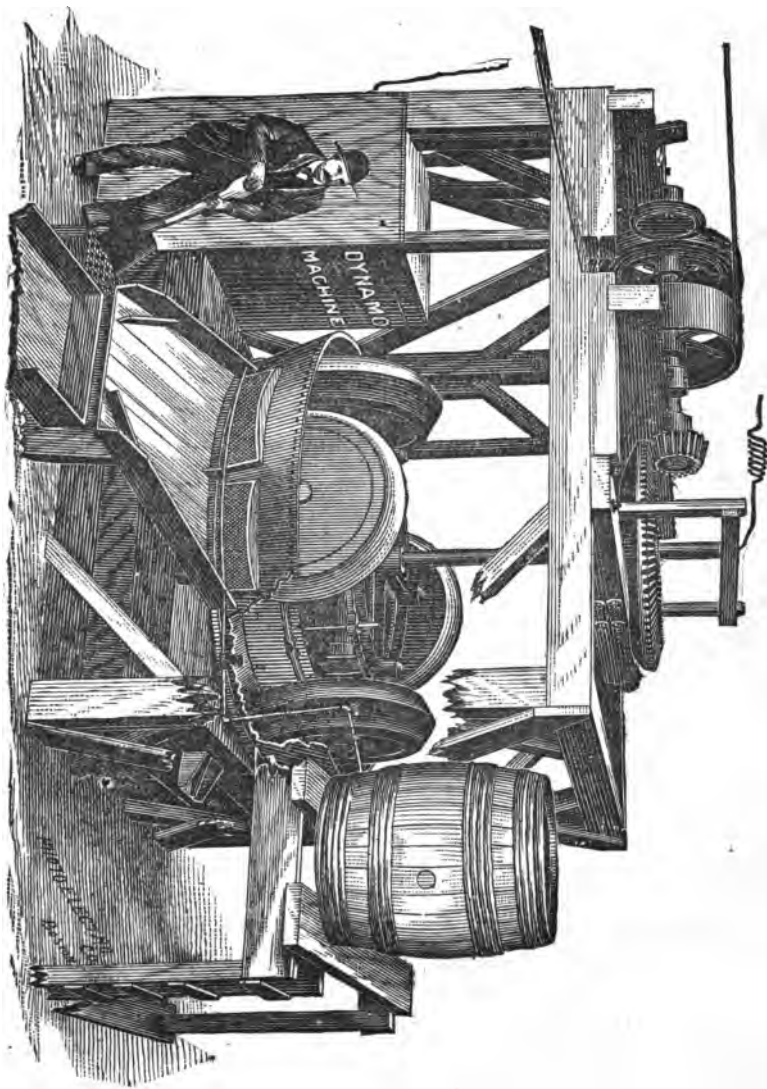
As can be seen by a glance at the cut here given, this machine is remarkable for the fewness and simplicity of its parts. That it is very substantial and not likely to break or readily wear out, is equally obvious.

Whether or not this company has accomplished all that is here claimed, certain it is they are laboring in the right direction, as electricity is destined to become a very important agent in the amalgamating process. In this department of mining nothing is of greater importance than the reduction of the crude ore to the necessary condition of fineness, and the final separation of the valuable metal from the worthless mass in which it is embedded. The measure of economical success attained in these two important respects, is the standard by which the machinery offered for acceptance to the mining world should be adjudged.

As an amalgamator the proprietors of the new mill claim for it a special importance. Every practical miner knows that aside from the daily expense in running, any method which will save one pennyweight more gold per ton of ore than any other, cannot fail to commend itself, as mining more than any other business, depends for success upon the use of the very best machinery and the greatest economy in methods. Every miner familiar with the working of gold ores, knows that on amalgamation depends success, and that the hard amalgam process of the stamp battery is both expensive and wasteful, as is also the soft amalgam process by the Closser, the Tumbler, the Howland pan or other *methods* where the pulp has to be taken from the crushing mill to be treated, none of which can be worked at a cost less than from \$3.00 to \$3.50 per ton of ore handled, while in this Mill, by a simple, beautiful and inexpensive method, a most perfect amalgamation, without neutralizing or flouring the mercury, is effected at a cost not exceeding 50 cents per ton. As an amalgamating mill no mining company working free milling ores can afford to be without it.

From the data above given it will be seen that in the important points of original cost, capacity for effectual work, and economy in running, this Mill has no equal, and when it is considered that all classes and conditions of ore, from the hardest and most refractory sulphurets, to the soft, clayey and gravel placers, and the black sands of the Pacific Coast, can be readily worked in it, making clean work of the whole product of the mine; it will be seen that its value to the mining community has not been over-estimated.

Mr. Jacob C. Wiswell, the inventor and patentee of this Mill, is no tyro in mining; thirty-three years spent in the business, as a successful manager and superintendent of mines, in the West and South, has made him perfectly familiar with all the various machines for crushing and pulverizing ore, which have thus far proved of any practical value; the Stamping Battery, the Cornish Rolls, the Chilian Mill, and the Mexican Arrasta, have all been worked by him,



and their excellencies and deficiencies noted, with the eye of a practical expert, both in regard to their effect upon the ores worked, and the economy of their operation, and in common with every experienced practical mining and millman, he has realized the necessity of something better adapted than any of these, to the rapid and economic necessities of the mining business of to-day.

In the Mill now introduced under his name, is combined the results of his years of patient study and practical experience; and it is believed, that while retaining all the valuable qualities of the best known mills, most if not all of their objectionable points have been eliminated, and many new and valuable improvements have been introduced.

To enter fully into details, showing all the points of superiority claimed for this Mill, would involve a detailed estimate of cost in operating the various crushing, concentrating and amalgamating processes as at present worked, which would be out of place here—but the main essential points have been briefly enumerated above.

A large number of these mills have been put up in the Eastern States and in the Rocky Mountain mining regions; also several in California, and it is due the proprietors to say they have invariably given the highest satisfaction, have accomplished all and even more than was promised or expected. We have not heard of a single complaint from those who have used them.

The General Agency of the Company on this Coast is at 106 Leidesdorff street, San Francisco, where all needed information in regard to the machine can be obtained.

ASSAYER'S MATERIALS, MILL SUPPLIES, CHEMICALS, &c.—THE HOUSE OF JOHN TAYLOR & CO.

With the subject of mining machinery, implements and processes, is naturally connected that of chemicals, chemical apparatus, assayer's materials, mine and mill supplies, prospector's outfit, etc. As it is of the first importance that

every article and utensil in this line should be absolutely pure and as nearly perfect as possible, purchasers should be careful to obtain their supplies of none but houses noted for their reliability in this respect. The slightest impurity in chemical preparations or the least inaccuracy in these delicate and nicely adjusted machines may defeat the best calculations in matters of moment, and thus work a serious mischief. In these chemical tests that have frequently to be made, the presence of an impurity almost infinitesimal in quantity, may render results worthless. A balance that in assaying fails to respond to the thousandth part of a grain, may prove fatally misleading. Where such purity and nicety are required, neither the assayer, the millman nor the metallurgist can afford to take any chances by buying their stocks of any but thoroughly well known and responsible parties.

With no desire to disparage others engaged in the business, we do hardly more than enunciate a generally recognized fact in stating that the house of John Taylor & Co., of San Francisco, have earned a wide and well deserved reputation for their fair and honorable dealings in this line of supplies. Being the oldest house in the trade west of the Missouri River, they have such an acquaintance with the wants, and such an appreciation of the business methods that obtain in the "Far West" as enables them to meet the requirements growing out of these special conditions, better than could be done by those entering the field more recently. This firm is composed of men educated and, we may almost say, born to the business, having been in it all their lives. They are practical chemists and conversant with all the arts and mechanisms pertaining to their calling; and can, therefore, perform every service connected with the same in an intelligent and efficient manner, and with little liability to mistake. Another advantage possessed by this house is the facilities they enjoy for obtaining goods direct from the most noted manufacturing establishments abroad, and from which they are constantly receiving fresh supplies of such

articles as they do not make at their own works in this city. Besides dealing in all kinds of assayer's materials, mine and mill supplies, chemical apparatus and chemicals, this firm have a long line of specialties, such as the newly invented Prospector's Balance, Taylor's Hand Ore Crusher, also a recent invention, Portable Furnaces, Prospector's Outfits, etc. They are also prepared to make on short notice, any new article or appliance required by millmen, assayers or metallurgists, whether of the ordinary kind or needed for special purposes.

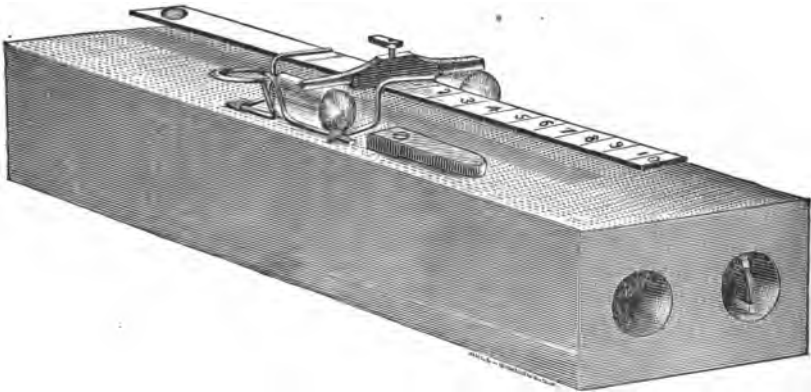
The Prospector's Balance, above alluded to, and a cut of which we give herewith, is the old English style, known as Black's Scale, improved by Mr. Melville Atwood, all his life connected with the mining interest in a practical way, and afterwards by Mr. Bohn; the machine at a still later date having been further improved by Mr. H. R. Taylor, of this firm, all of which improvements will be covered by letters patent already applied for. • The improved scale has a pan suspended from one end of the beam, and a new lifting apparatus, the whole when not in use being inclosed in a glass case, placed in a strong tin box $8\frac{1}{2} \times 2 \times 2\frac{1}{8}$ inches, and in which it can be carried safely.

This balance supplies a simple working test for gold ores, whereby the amount of metal they contain can be readily and accurately determined by the prospector or others not accustomed to the use of the ordinary scales or balance, a want long felt by the non-professional class of miners.

ATWOOD'S BLOWPIPE AND PROSPECTOR'S BALANCE.

This balance, the frame about seven inches long, consists of a German silver beam, six inches long and one-fourth of an inch wide, the fulcrum knife, edged and the bearings pieces of round glass. On the right hand side of the fulcrum, ten divisions are marked at equal distances from each other, and on the left hand side a small depression is made

to receive the globules of metal or a small pan for gold dust. Above the fulcrum is a small vane, which being turned to the right or left adjusts the beam to equilibrium. The two small wires resting upon the beam keep it in place while the globules to be weighed are being placed on the beam. By a very slight pressure with the finger, the wires are raised and allow the beam to work. The number of weights required are three, made of flattened wire, viz: 10 grains, 1 grain and 1-10th of a grain. The weights are moved from one division to another as required to balance the globules, keeping the flat side on the lines of division. This balance is very sensitive and will weigh to the one-thousandth part



of a grain. Gramme weights will be furnished in place of grains, if desired. Holes are made in the wooden block to hold the blow pipe, pincettes, weights, charcoal, etc. A table accompanies the machine for estimating value of the gold contained in a ton of 2,000 pounds.

TAYLOR'S PATENT HAND ORE CRUSHER,

Invented by one of the members of this firm, is an implement for crushing ore for assaying or working purposes, one of these crushers of hand size being shown by the cut here presented.

By this machine a person can quickly and easily reduce the hardest ore to a sufficient fineness for assaying, sampling or working, the advantages of using it for the above purposes being so obvious that no person having much of that sort of work to do, will, after witnessing its performance, consent to be without one. These machines are made

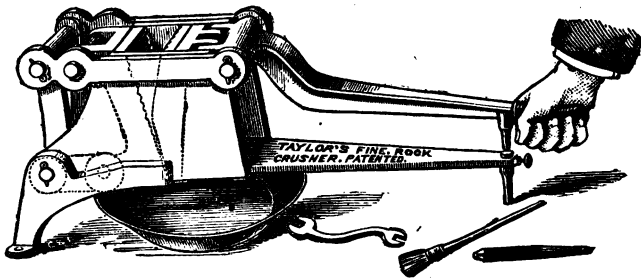
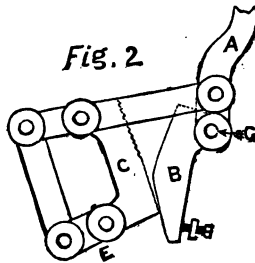


Fig. 2



of various sizes, their crushing capacity ranging from 500 to 2,000 pounds of ore per day, the larger size being driven by other than hand power. With every machine there goes a circular, describing more fully its various parts, its uses and the mode of working it.

PROSPECTOR'S OUTFITS.

No prospector should ever start on a tour without having first procured such a kit of tools, chemicals, etc., as can at small cost be obtained of this house, and which will enable him, even though no assayer, to make a quick and correct

test of gold, silver or copper contained in any rock he may find.

Parties wherever located, desiring anything in the line of this house, have only to send their orders to John Taylor & Co., 112 to 120 Pine street, San Francisco, California, to insure their being promptly filled. For catalogues and price list, sent free, address as above.

GIANT POWDER OR DYNAMITE—ITS USES AND ADVANTAGES IN MINING.

This is one and the same substance, being in the United States commonly called Giant Powder, and in European countries, Dynamite. It is made by mixing nitro-glycerine with infusorial earth or similar materials. It is the invention of *Alfred Nobel*, a distinguished Swedish chemist, in world-wide repute among scientists for his researches in explosives, especially Nitro-Glycerine and its compounds. His father, a Swedish chemist of high standing, commenced experimental investigations as to the nature and properties of Nitro-Glycerine, then a recent discovery of the chemist Sombbrero, which were continued after his death by his sons, one of whom lost his life in the prosecution of these investigations and studies. Alfred Nobel was the inventor of the present mode of nitrating glycerine on a large and economical scale, thus introducing it into the domain of mining and the useful arts. He first attempted to utilize Nitro-Glycerine by mixing it with black powder, but subsequently, in 1866, he discovered that by mixing it with about one-third its weight of an inert substance of great absorbent power, such as infusorial earth or its equivalent, Nitro-Glycerine could be handled and used with little or no danger. This discovery was followed in 1869 by his substituting in place of an inert absorbent, nitrate of potassium or other equivalent salt, mixed with a proper proportion of carbon, thus producing the Dynamite in use to-day—a cheaper and consequently more useful explosive than the

first dynamite invented by him, the whole explosive power of which was derived from nitro-glycerine. The power of this compound can only be estimated theoretically, but its uses are manifold, and do not need to be specified. Nobel's invention was not long in attracting attention. It soon came into use all over the civilized world; but like every other good article, many imitations were put on the markets under various names. He secured patents for it, however, where possible. When it had attained considerable fame, the inventor was attracted to the United States as a new field of operation. Not being a citizen, he could not patent the article here, but through his friend, Mr. Julius Bandmann, this was however finally done. Mr. Bandmann was senior partner in the commission house of Bandmann, Neilsen & Co., of this city, a firm dating back to 1849. In 1868 they changed their line of business, and began handling Mr. Nobel's patents. Mr. Bandmann sold to the Giant Powder Company, a new incorporation, the right to use the powder on this coast, and in the following year the entire right for the United States, his firm remaining general agents. As now organized there are two factories in this country, one in New Jersey and one here, the Eastern Division going under the name of the Atlantic Dynamite Company, and this under the name of the Giant Powder Company, both however being managed by one board of directors located in San Francisco, with Albert Dibblee, President, Louis B. Chapman, Secretary, Sather & Co. and the London and San Francisco Bank, Treasurers. Under such management, three kinds of powder are made—Nobel's Explosive Gelatine, the strongest, a brownish looking article of the consistency of half solidified glue; the Giant Powder, ranking next, and the Judson, third. After the Giant Powder had been established three or four years, other companies sprung up, notwithstanding the sole rights secured to the Giant Powder Company under the Nobel patents; the products of those companies are all copies or imitations of Nobel's original invention of dynamite, which is simply nitro-glycerine held in an

absorbing body. This substance in its fluid state, is an oil produced by the mixture of nitric acid, sulphuric acid and glycerine, and is liable to explosion when transported in that condition. Nobel changed this into a paste or powder, in which the nitro-glycerine is cushioned, thus making its transportation and handling entirely safe. As a blasting agent, the fluid would be impracticable, as it could not be used in horizontal or upward boreholes, except by putting it in tin tubes or some such appliance. The strength of the Dynamite or Giant Powder depends to a great extent on the amount of nitro-glycerine used, and as it is a very difficult matter to test this, some manufacturers get over the trouble by using less of that material, the article produced being diminished in power to a corresponding degree. Consumers should therefore be careful to deal only with companies of undoubted honor and integrity. A few years since, Mr. Nobel succeeded in producing a still stronger powder than the strongest dynamite, the strength of the latter being limited by the absorbing qualities of the absorbent used. This is called Nobel's explosive gelatine. It contains 94 per cent. of nitro-glycerine, whereas dynamite cannot safely hold more than 75 per cent. It is even safer in handling and transportation than dynamite, as it requires for its explosion a specially prepared primer, which is exploded by a giant powder cap, whereas dynamite explodes readily with a heavy percussion cap. This gelatine is entirely impervious to water, and therefore specially adapted for submarine blastings. It has been largely used in the last two years on the great tunnels bored in Europe; such as the Arlberg in Austria, the St. Gotthard in Switzerland, and has been pronounced by the intelligent engineers who had charge of those great works superior to dynamite. The Judson Powder is a low explosive, the result of much experimenting. It is three or four times stronger than blasting powder, and has met with remarkable success in railroad work, on account of its superior strength and crushing qualities. For farm work, such as removing trees, stumps, etc., it is invaluable. These

three powders can be obtained of standard strength and in their purity, of the firm of Bandmann, Neilsen & Co., at their place of business, 210 Front street, San Francisco; the firm furnishing to parties desirous of purchasing or making inquiry in regard to these explosives, pamphlets and circulars containing all needed information for handling them with safety, and employing them with effect.

The use of Giant Powder met from the outset with much opposition, and this from various sources and for various alleged reasons. First, its introduction was opposed by the manufacturers and vendors of common powder on the ground of interest, which in a commercial point of view, was proper enough. Then the underground miners opposed it, complaining that it gave them a headache and otherwise proved injurious to health. With the use of this powder came also single hand drilling, dispensing with one half the men before required to perform the same amount of work, whereby there was supplied an additional reason for its introduction being opposed by the miners.

But such opposition soon disappeared. The manifest superiority of this over black powder led to its being almost at once largely substituted for that article, both in mining, railroad construction, and almost everything else. The complaint about its being injurious to health turned out to be a mere pretext of the miners, being without any sufficient foundation. The diminished cost of mining operations, effected through its employment, so increased these operations that as many drillers were employed as before, and so opposition on the ground of diminished labor also came to an end, the new explosive, all opposition overcome, having rapidly grown in public favor.

Great advantages have been found to accrue from the use of Giant Powder in driving tunnels, sinking shafts, running levels and stoping out ores where the rock is especially hard, this explosive, by its instantaneous action producing effects so vastly superior to those resulting from the use of common powder. Unlike the latter, this powder never

blows out of the drill hole, but tears away the bottom and sides in all directions, without seeking as it were the line of least resistance. As early as 1868, it was demonstrated by actual working tests made in California, that the cost of breaking out hard rock with Giant Powder and single hand drilling and the cost of accomplishing an equal amount of work with black powder and the old method of drilling, was as 51 to 92 in favor of the former.

Another consideration, and one often of great moment, is the extent to which the employment of Giant Powder hastens forward operations. The Central Pacific Railroad Company calculate that more than a year's time was saved by substituting nitro-glycerine for common powder in driving their long "Summit Tunnel" through the Sierra Nevada. As the net earnings of that company amount to several million dollars, this is the sum total of gains represented by the year so saved.

Recapitulating somewhat, the following may be stated as some of the special advantages attending the use of these new and more powerful explosives:

1. A great economy in labor for boring.
2. The rapidity of blasting operations, which is of vital importance, especially for mines and railway tunnels, can be made with Giant Powder in half the time required with black powder.
3. Perfect safety in carrying, storing, and handling it.
4. A complete combustion, which leaves no smoke or noxious gases.
5. The quickness of explosion is so great that fissured rocks and clay are easily blasted with it.
6. Great saving in wear and tear of tools, and in consumption of steel and fuse, fewer bore-holes being needed.
7. No tamping but water or loose sand being required, the loading is attended with no risk, but with a saving of time and expense.
8. In boulder blasting in gravel claims it is very superior, as in all ordinary boulders, too large to be easily removed

by manual labor, a small charge of Giant Powder in a hole made with a half-inch drill and three-pound hammer, will shatter the boulders so they can easily be handled.

9. Its use under water or in water-bleeding rock is very simple and the effect very great.

10. It is very useful for blasting heavy blocks of iron, steel, or metal, which cannot be blasted by gunpowder, but easily yield to small charges of Giant Powder.

11. For military purposes, in springing mines and removing palisades.

A fair trial never fails to prove a complete success. The first blasts are conclusive as to the great superiority of Giant Powder over gunpowder, but its full economical value can only appear when those who use it use single-handed drills, and at the same time gain experience enough not to waste its power by overcharging or requiring impossibilities of it.

The consumption of Giant Powder, produced in California, has averaged during the past five years about 4,000,000 pounds per annum. As underground mining operations are extended, and the great merits of this explosive become better known, its use, including that of Nobel's Gelatine and Gelatine Dynamite, is bound to undergo a steady and rapid increase.

EDISON'S ELECTRIC PEN—UTILITY IN MULTIPLYING MANUSCRIPTS, MAPS, ETC.

Frequently the miner, after procuring reports with maps to be made upon his properties, requires a number of copies of the same to be afterwards made. To avoid the cost of having these reproduced by means of printing, lithographing or engraving, it is best to have this work done by the Electric Pen Process, which, while it turns out work of great artistic beauty, costs but little. This style of calligraphy, a device of Edison, the great electrician, is one of the most remarkable inventions of the age, being hardly less ingenious than the telephone itself. Incredible as it

may seem, more than five thousand impressions of any writing, map or diagram, can by this method be taken from a single paper, every copy produced being, in all respects, a *fac simile* of the original. It can, in fact, be made serviceable for cheaply and rapidly multiplying copies of all written or printed matter requiring to be duplicated, and for such purpose is now being employed by private parties, business establishments and public functionaries throughout most parts of the civilized world.

While this system so recommends itself on the score of economy and neatness, it becomes the only method whereby secrecy can be insured in transacting business of a private and confidential nature, as by it all the work is performed by a single person instead of passing through many hands, as when done by printing, lithographing, engraving, etc.

The General Agent for San Francisco for this process, and the mechanisms for executing it, is Mr. E. A. Dakin, room 44, No. 320 Sansome street.

This gentleman, having had long experience at the business, is an adept in the use of the Electric Pen, a sample of his work being given in the back part of this book. As Mr. Dakin performs his work promptly and in a superior manner, so are his charges extremely moderate.

AMALGAMATING GOLD—USE OF SILVERIZED COPPER PLATES.

The effecting of a cheap and thorough amalgamation of gold has always constituted one of the principal troubles of the millman and metallurgist. Formerly blankets, gunny-sack, and other fibrous materials were mainly employed for this purpose. Being ineffective, costly and troublesome, these textile fabrics have come to be almost wholly superseded by the use of copper sheets plated with silver by voltaic electricity or galvanism. These silverized plates possess great advantages, not only over the fabrics mentioned, but also over the unprepared or ordinary sheets of copper, the

large amount of quicksilver they are capable of holding enabling them to catch and retain the fine and float gold which escapes these other appliances, the extra quantity of gold so saved paying the entire cost of these articles in a very short time. They are of simple construction, easily attended and kept in order, and capable of being replated when the silver wears off.

The most extensive and the earliest established Silver Plating Works on the Pacific Coast, are at 653 and 655 Mission street, San Francisco, E. G. Denniston, proprietor.

By reason of the superior work here turned out, this establishment does a large business—more, perhaps, than all others in the city combined, the Denniston Plates being in general use throughout the entire mining regions west of the Rocky Mountains; also in Mexico and Central America.

As it is important not only that the work be well done, but that the silver applied to the plates be of full weight, they should be ordered of none but reliable and responsible parties, such as Mr. Denniston is known to be. It is said that this manufacturer has in his possession more than a thousand letters from millmen and metallurgists on the Pacific Coast, testifying to the superiority of his Silverized Copper Plates. He has also been awarded the First Premium at all the Fairs of the Mechanics' Institute for the last twelve years.

These Plates are made to order—plain, corrugated or rifled, and of any size, shape, or thickness of copper desired. The silver is put on by weight, the amount being determined by the prices, which are as follows: \$2.00, \$2.50, \$3.00, \$3.50, \$4.00, \$4.50 and \$5.00 per square foot, price of copper added.

CALIFORNIA MACHINERY AND MACHINISTS— THE RISDON IRON WORKS—A REPRESENTATIVE ESTABLISHMENT.

For several years following the discovery of gold in California, there was little demand for large, complicated or

costly machinery, the simple implements first in use, such as the sluice, long-tom and rocker, sufficing to extract and save the gold contained in the surface gravel. But gradually, as these shallow and easily worked deposits became exhausted, there came requirements for more powerful machines and costly appliances adapted to working the auriferous quartz lodes, the hydraulic banks, the drift diggings, and other forms of deep-lying placers. To meet these requirements foundries, machine shops and iron works of various kinds were started, the most of them being of limited capacity at first, though nearly all afterwards underwent steady expansion, keeping pace with the growth of the mining industry. How the primitive quartz mill grew into the perfect structure of the present day, and how the rawhide hose enlarged itself into the enormous pipes and nozzles seen in the modern hydraulic mine, having been fully described in preceding pages of this book, more on this subject need not here be said, though we shall a little further on have something to say about the manner in which the feeble arrangements first in use for raising water have expanded into the tremendous enginery employed for draining the lower levels of the Comstock mines, where water is lifted from a depth of more than three thousand feet. There is something phenomenal in the way in which the methods, implements, and mechanisms employed in the business of mining on this Coast have been advanced from the smallest beginnings to their present development; these processes exemplifying the doctrine of evolution as completely as anything occurring in nature. Starting with the most crude and imperfect products, steady advancement has since been made, one improvement having followed another until we are fain to believe the limit of possible progress may have been almost reached.

In furnishing mining equipments California outranks the world, the pre-eminence of our master mechanics in this department of manufacture being universally acknowledged. The superiority of our plant, whether required for purposes

of exploitation or ore reduction, has been practically endorsed by the orders received for it from nearly all parts of the world—even British mining companies operating in Mexico, South America and Africa, giving it a preference. This manifest excellence of our mining outfits has been due to the fact that there has always existed here a large demand for this class of manufactures, while customers have been so exacting in their requirements, and competition has been so sharp, that none but establishments capable of doing supremely good work have stood any chance of building up a remunerative or even a living business.

While we have in California, located mostly in San Francisco, a number of foundries and machine shops that in extent and perfection of plant compare favorably with any found elsewhere, we select one of these establishments, the Risdon Iron Works, of this city, as typical of all that is best and most advanced in this line of manufacture on the Pacific Coast, and to which belongs, also, the distinction of having constructed and put in place the most gigantic and effective system of hydraulic pumps ever brought into use in this or any other country.

Before recounting more of their exploits, it may be proper to say a few words about—

THE ORIGIN, CAPACITY, AND EQUIPMENT OF THESE WORKS,

Which were erected by a company of San Francisco capitalists and practical machinists, incorporated for the purpose, in 1868, and which, commencing operations at that date, have done a large and steadily increasing business ever since. Anticipating future requirements, this establishment was supplied with all the means and appliances necessary for making everything needed in the various departments and operations of mining; and, in fact, almost every other material industry, the construction of massive, complicated, and powerful machinery having been made a specialty from

the start. They have here facilities for making anything from the most delicate tool to the most colossal pump, or the largest sized locomotive or stationary steam engine. This company can, in short, fill any order ever likely to be sent them, their plant embracing tool and machine making machinery of every kind. Frequently it has happened that work, which nowhere else would be undertaken, because of its difficult and ponderous character, has been executed here with ease and dispatch.

When the "Combination" shaft, in the Consolidated Virginia and California mines, on the Comstock lode, had reached a depth of about twenty-two hundred feet, it became a question whether or not any further downward progress could be made with that work, owing to the extreme heat and the great influx of water at that point. The owners of these mines, consulting with eminent engineers, were advised to abandon further sinking as being impracticable, owing to the great height this large volume of water would have to be lifted. In this dilemma they applied to the proprietors of the Risdon Iron Works for their opinion on the subject, asking them if they could build pumps adequate to this difficult service. Being told that they could, these mine owners, after some further counseling with others, who discouraged the undertaking, in the belief that it would end in failure, finally ordered the Risdon people to go ahead and build the pumping machinery according to their own plans, which they accordingly did. The results have fully vindicated the judgment of these people. The pumps they built and put in place have performed their duty so well that the shaft has been sunk to a total depth of more than three thousand one hundred feet, having kept the lower levels of the mines perfectly drained, the water having been lifted to and emptied into the Sutro Tunnel, that intersects the Comstock lode sixteen hundred feet below the surface.

These pumps, which are capable of raising three thousand gallons per minute through the above lift, have been running

continuously since they were erected, without being apparently much the worse for wear. This achievement is not only unexampled in the history of mining, but is probably without parallel in hydraulic exploits of any kind. These powerful machines are operated with great economy, the propulsive power consisting of water obtained at small cost from the Gold Hill Water Company, and which, after serving this end, is raised and discharged into the Sutro Tunnel.

At these Works has since been manufactured an almost equally powerful system of pumps for the Eureka Consolidated mine, in the State of Nevada. The motive power here also consists of water applied under a pressure of one thousand pounds to the square inch. This water, after performing its function, is raised by a steam engine to the surface, emptied into an "accumulator," and again dropped to the six hundred foot level, where the pumps are stationed, and thus used over and over again with but little wastage.

In all the leading mining camps in California and Nevada, as well as in most of those in the other Pacific States and Territories; in Alaska and at many places in Mexico, Central and South America, can be seen machinery from the Risdon Iron Works; the furnaces and pumping gear at the New Almaden Quicksilver mine; the plant for the Plymouth mine, Amador County; the hydraulic machinery for the Spring Valley Company at Cherokee, Butte County, and the 120-stamp mill erected the past summer in Alaska, all of extra large size and capacity, came from this establishment. The enormous iron pipes recently laid down by the Spring Valley Water Company, of San Francisco, were also made here. This Alaska mill, besides being the largest, is no doubt one of the most substantial and complete to be found in the whole world.

Without multiplying these instances of the extraordinary performances of the Risdon Company, of which hundreds of like import might be cited, it is enough to say, that they fairly represent, as before remarked, all that is best and

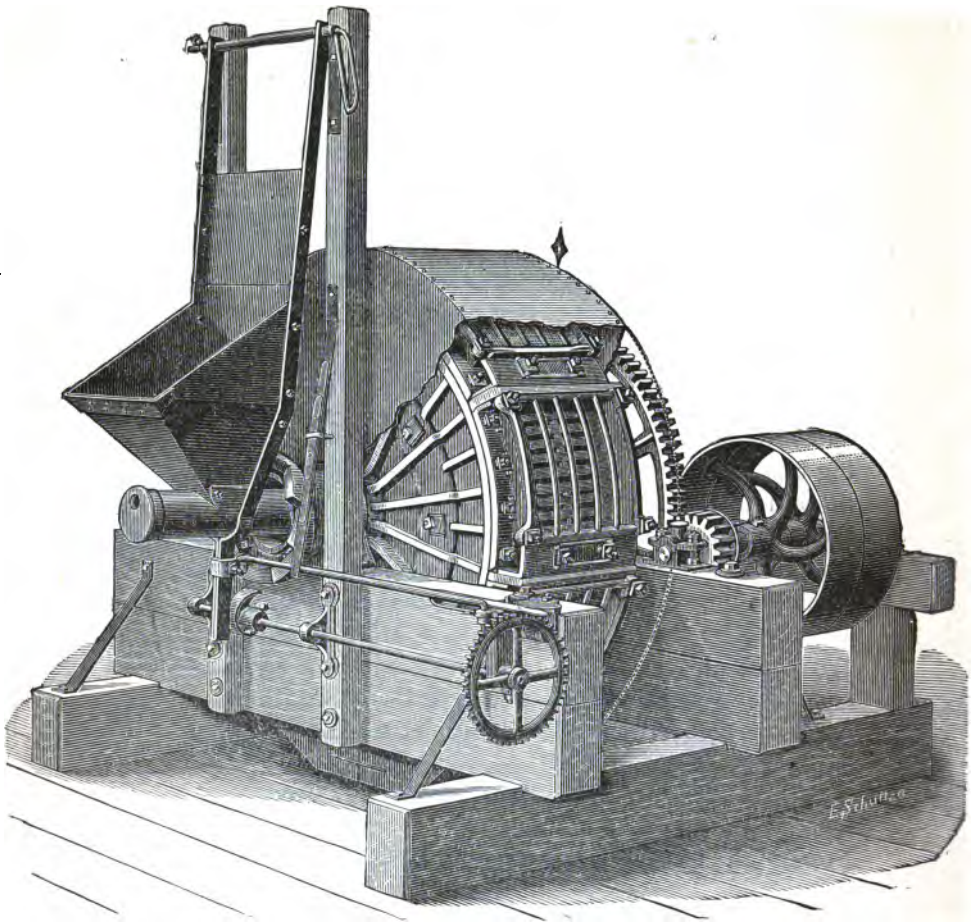
most advanced in the special industry of which they may be said to be at the head.

NEED FOR CHEAP AND EFFECTIVE ORE CRUSHERS—MACHINES THAT BEST MEET THIS WANT.

While the California gold fields contain many vein deposits of great magnitude, they are still more noted for their immense number of small veins of this kind. For working these latter, ore crushing machines of only limited capacity is required. To meet this want, now very extensive, many small mills have, first and last, been invented and put on trial. Unfortunately, however, only a few of these candidates for public favor have been able to long survive a working test of their merits. Hardly more than two or three can be said to have withstood such practical ordeal. Among these survivors, the Tustin Rotary Pulverizer, and the Huntington Centrifugal Roller Quartz Mill seem to occupy the foremost place, having up to this time, been preferred over all others by the quartz miners of California and the Pacific Coast generally. In the interest of this class of miners, we outline here the leading features of these two machines; also point out some of the advantages claimed for each.

THE TUSTIN MILL

Is not only a pulverizer, reducing the ore to a proper fineness for amalgamation, but it is also a granulator, bringing the sulphurets into such shape that they can be successfully concentrated while it forms but little slime. It is capable of working ores, either wet or dry, and feeds itself automatically. We present here a cut of this mill with a portion broken away to show the interior arrangement.



The cylinder in this (the largest sized machine) is 54 inches in diameter, 18 inches between heads. Slotted dies secure the circumference of the heads in place, and wire screens are secured outside of all. Inside the cylinder, and resting loosely on the dies, are two cast iron rolls, weighing respectively 700 and 1,000 pounds.

The cylinder revolves on journals, and is driven by a gear which turns it 25 times a minute. The ore is fed from a

hanging hopper through one of the journals which is hollow. In action the rolls revolve in the opposite direction from that in which the cylinder turns. The ore being fed in, is crushed between the rolls and the dies, and drops through the slots in the screens, where what is fine enough is sifted through, and what is too coarse is again carried under the rolls. Horse power required, $3\frac{1}{2}$; capacity, 30 tons roasted ore per 24 hours, or from 10 to 20 tons raw ore, depending on its hardness.

For this machine the inventor and manufacturer claim the following, among other special points of merit: cheapness; lightness of weight, being comparatively small; compactness, requiring but little room; requires but little power to run it, $3\frac{1}{2}$ horse power being sufficient; is easily set up, two men being able to put it up in two days and no special foundation being required; it runs so slow that it does not heat, makes no noise, and creates no dust; it feeds itself automatically; granulates the ore uniformly, and makes but little slime which so interferes with successful amalgamation, leaching or concentrating; the wearing parts are durable, consisting of hard cast iron, which can be readily removed and new parts put in, and is so simple in all its parts and construction, that but little skill is required for setting it up, repairing or running it.

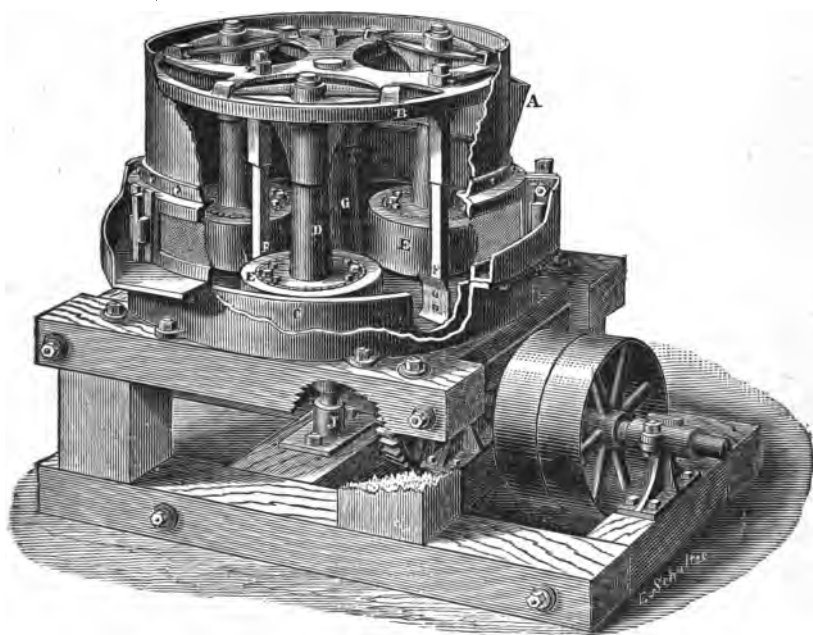
The patentees and manufacturers of the Tustin machine have numerous letters from millmen and metallurgists testifying to its good points as above set forth. It has also on several occasions been awarded a premium by the Mechanics' Institute, as the best quartz mill exhibited, whether for wet or dry crushing.

One of these machines can be seen at the Ore Sampling and Pulverizing Works of Messrs. Hofmann Brothers, S. W. corner Fifth and Bryant streets, San Francisco, where it is in daily operation. It is the smallest size, capacity equal to a five stamp battery, and will pulverize from five to ten tons in twenty-four hours, according to the hardness of the ore, through a No. 40 mesh screen, $1\frac{1}{2}$ horse power required.

Weight, 5000 lbs.; heaviest piece, 425 lbs. Price \$600.00. Larger size, weight, 11,000 lbs.; heaviest piece, 1,100 lbs.; price \$1,800.00; capacity, 12 to 20 tons per day; $3\frac{1}{2}$ horse power required.

These mills, together with the Tustin Rock Breaker, are manufactured by Hinckley, Spiers & Hayes, at the Fulton Iron Works, office 220 Fremont street, San Francisco, these parties being also agents for the Pacific Coast.

THE HUNTINGTON CENTRIFUGAL ROLLER QUARTZ MILL



Stands in the front rank of the low priced but effective quartz crushers of the present day, having been received with great favor by the mining public of the Pacific Coast. The various parts of this machine, set up and ready for use, are shown in the subjoined cut.

The ore and water being fed into the mill at the hopper H, the rotating rollers and scrapers throw the ore against the ring die, where it is crushed to any desired fineness by the centrifugal force of the rollers as they pass over it.

The water and pulverized ore are thrown against and through the screens when fine enough. The discharge is so perfect that it makes little or no slimes, and leaves the pulp in good condition for concentration. The rollers are suspended, leaving a space of one inch between them and the bottom of the mill, thus allowing them to pass freely over the quicksilver and amalgam without grinding it or throwing it from the mill, while it agitates it sufficiently to make amalgamation perfect. For wet crushing and gold saving it has probably no superior.

In the matters of cheapness, both as regards the cost of plant and expense of operations, in ability to save gold, ease of transportation, economy of setting up mill and in motive power, and in the extreme simplicity of parts, great advantages are and very justly may be claimed for this machine, many of which have come into use throughout all parts of California. While this mill wholly avoids the flowing of gold, it is especially adapted for working ore containing sulphurets, the rotary method of crushing so granulating the pulp, which is discharged the moment it is crushed, that a complete concentration of sulphurets is insured.

The Huntington Mill has now passed entirely through the experimental stage. Three years of continuous use at numerous mines, has enabled the inventor to perfect and improve the machinery until he feels justified in assuring the public that he has reached *the absolute* in the construction of a perfect quartz mill.

These mills are manufactured by Messrs. Hinckley, Spiers & Hayes, of the Fulton Iron Works, 220 Fremont street, San Francisco, the principal office being at 45 same street.

DRIVING BIG TUNNELS.

The extent to which the undertaking of heavy enterprises is encouraged through the employment of the various time, labor, and money saving implements and agencies being introduced, is well illustrated by the several large tunnels now in progress in this State and elsewhere on this Coast. For a description of one of these enterprises, and some remarks bearing on the subject in hand, we are indebted to *Wood and Iron*, a San Francisco publication, devoted chiefly to the advancement of the material interests of the State.

"During the earlier stages of mining on this Coast, the driving of tunnels, whether for the development of drift or vein deposits, was a very expensive business, the work of rock removal having been accomplished wholly by hand drilling. The cost, and the great length of time required for the performance of this part of the work, were the causes that led to the failure of so many of these mining enterprises at that day. As many as six or eight, and often ten or twelve years, were consumed in opening up a drift claim, the length of time alone being frequently an element that caused defeat—companies weary with waiting, going to pieces and disbanding. Since, however, power drills, driven by air compressors, have come to be employed on these works, they have been completed in better shape, at reduced cost, and in less time than formerly, causing more of them to be undertaken, and insuring success where before failure would have been almost certain. Where adits of extra large size are demanded, the amount of time and money required for their construction would, by the old methods, have been so great that very few of them would ever have been built—the Big Bend Tunnel, on Feather River, being a case in point. Such confidence had the miners of that vicinity in this scheme, that they contemplated for many years the design of attempting themselves to carry it out, and would no doubt have done so ultimately had not other parties taken hold of it.

"A company having been formed in the Spring of 1883, with a view to prosecuting this enterprise, commenced active operations in the month of April of that year. This tunnel, which is of the following large dimensions: fifteen feet wide, ten feet high, and twelve thousand feet long, is intended to divert the water of Feather River from its channel, and so lay bare its bed for a distance of thirteen miles, that it can be worked for the gold it is supposed to contain. This company contracted with the old and well-known house of Parke & Lacy, of San Francisco, to furnish and set up power drills on this work. Since commencing, nearly two and a half years ago, these machines have advanced this tunnel at the average rate of three hundred and twenty-five feet per month, the total length of the adit being now something over ten thousand feet. The machines here in use are the Burleighs, for which, as well also as for the Ingersoll Drill, this firm are the agents on the Pacific Coast.

"This last mentioned machine has been employed on nearly every public work of magnitude in the United States, and also on many in various other parts of the world.

"On the South Pennsylvania Railroad, where seven miles of tunnel are being driven, ten of the eleven plants are said to be Ingersoll exclusively, such being also the case on the four and three-quarters mile aqueduct tunnel being driven for the City of Washington.

"On the New York thirty-eight-mile aqueduct tunnel, Brown, Howard & Co., the contractors, use the "Eclipse" Drills and "Straight Line" Air Compressors exclusively. Nineteen of the twenty-three large tunnels which have been driven with machine drills in this country, have employed the Ingersoll Drill.

"The Ingersoll Drill, mounted on the Patented Adjustable Column, was first used in driving tunnels of large size in the adit, twenty-four feet by twenty-seven, carried under West Point, in the State of New York. Since that time the machine has been employed in thirteen railway tunnels in different parts of the United States.

"In speaking of Messrs. Parke & Lacy, it is due that firm to say they have achieved a notable success in this line of business, having furnished drills and, in fact, mining machines of all kinds to many of the large companies west of the Rocky Mountains, and even to some operating on the easterly slope of the Cordillera. Where complicated and powerful machinery is ordered, the work of setting it up and running it for a time, receives, whenever needed, more or less supervision from a member or representative of the firm, a policy that has rendered this house popular in mining communities, and tended to greatly enlarge their business. Parke & Lacy were the pioneer importers of the power drill and air compressors on this Coast, and it was in a great measure owing to their efforts that these machines have been brought into such general use throughout the Pacific States and Territories. They were also the first to introduce these machines into the Northern provinces of Mexico, some recently having been sent by them to South America, and as far west as Japan. The introduction of this class of labor saving machinery into the mining districts of the far west has done more than any other one thing to promote great enterprises directed to the development of their mineral wealth, the cost of labor throughout these regions having before deterred capitalists from engaging in works of this kind."

AMALGAMATION — CONTINUOUS SYSTEM OF CONDUCTING THE PAN PROCESS.

By the old method of amalgamation, still largely in use, the pulp as it comes from the batteries is conducted into tanks or vats and there left to settle. These receptacles being filled the pulp is shoveled out and thrown in heaps in front of a row of pans, into which it is again shoveled when the latter are ready to be charged. The charge, after a treatment of five or six hours, is drawn off and run into a settler, where it is subjected to a further but not very differ-

ent treatment, the muller being run slower with a view to causing a precipitation of the quicksilver, while the sand and the finer particles remain suspended in the water, which accomplished, the entire contents of the settler are drawn off through a hole near its bottom.

Now, the shoveling of this mud over so many times involves a deal of disagreeable labor, these pans and settlers while running also requiring constant looking after. Then, too, there occurs by this method more or less wastage of the precious metals, while in running off the settlers a good deal of quicksilver is flooded away.

Observing this inconvenience, wastage and loss of labor, Mr. M. P. Boss, the well known milling engineer, of San Francisco, applied himself to find a remedy, which resulted in the invention of a cheap and effective device styled by him the Continuous System of Pan Amalgamation, whereby these defects of the old method are obviated.

By this new and improved plan, the pulp is run from the battery into a receiving or sampling bowl, whence it is conducted into a series of pans, the first of which being filled, overflows, and through a connecting pipe fills the next, and so on till the whole are filled. From the last pan in the series, the pulp is conducted into a series of settlers, through which it flows, and from which the tailings escape. A quicksilver bowl is attached to each pan whereby the amalgam can at any time be readily drawn off. This done, a fresh supply of quicksilver is let in from the charging bowl.

For the new arrangement the following advantages may justly be claimed: All handling of the pulp is avoided; the ore comes in contact with fresh quicksilver several times in its course; any quicksilver that escapes must flow through all the settlers, while none can be flooded away as there is a constant, easy current. In the management of ores that require protracted and elaborate treatment, its superiority becomes strikingly apparent. By use of the "Continuous," there is no time lost in drawing off and re-charging. The pulp in the first pan may be quite warm and made practi-

cally a chemical solution, causing action to begin as soon as the ore enters the pan, a stage that where charging is practiced, can be attained only after much time has elapsed. In short, Mr. Boss, while eliminating the objectionable, may be said to have incorporated into his system all the good features pertaining to the old methods. Where this system is adopted, something can be saved, too, in mill construction, especially in the matter of grading and retaining walls. There is also a saving in friction, journals, belting, etc.

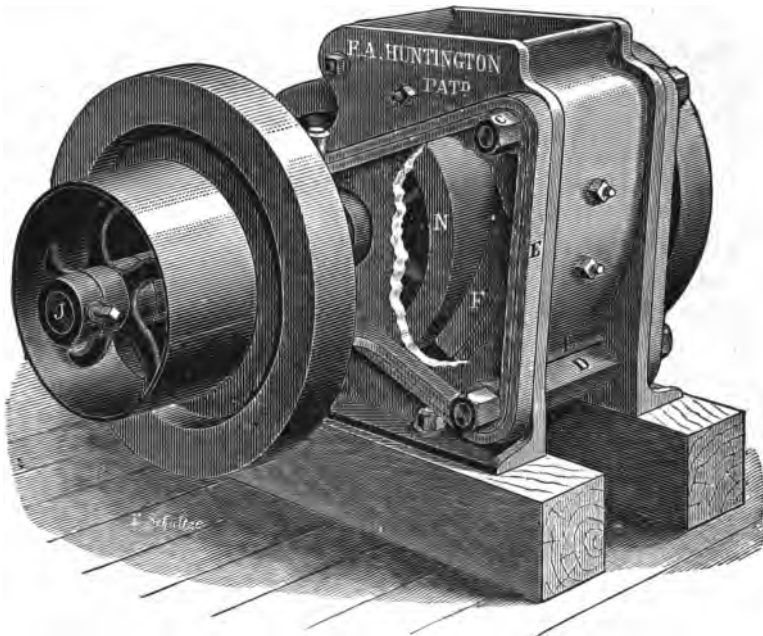
Such slight troubles as are incident to all new devices having been obviated by the inventor, this Continuous System of Amalgamation has since been introduced into a large number of mills throughout all parts of the Pacific Coast, affording everywhere complete satisfaction, as is attested by the certificates of numerous millmen and metallurgists after practical tests made.

These amalgamators are manufactured at all the leading foundries in San Francisco, where they can be seen, and where also all needed information in regard to them can be obtained.

A NEW STYLE OF ROCK BREAKER.

F. A. Huntington, inventor of the centrifugal roller quartz mill, is also the inventor of an ore or rock breaker, distinguished for every quality most desirable in a machine of this kind, being cheap, portable, durable and effective. There are to this crusher, a cut of which is herewith given, but two working parts, viz: the eccentric shaft J and the cylindrical jaw N, through which the shaft J passed loosely. By rotating the shaft J, the jaw N is moved to and from the stationary jaw F, crushing the ore between these two points, the same as in the ordinary jaw crusher. When crushing, the jaw N moves slowly around in the opposite direction to the eccentric shaft J, thereby causing an even wear around the whole surface of the jaw, which has ten times the wearing surface of those used in the ordinary crusher. This

slow rotating movement also materially assists the discharge of wet ore. By dropping plates L between the bar D, and jaw F, the ore can be crushed to any desired fineness. The wrought iron bands E, pass around the bearing of the eccentric shaft J, and the bolts C and D take all the strain from the cast iron sides, thus enabling them to be made light and strong.



IMPROVED ORE CRUSHER.

The special claims of excellence for this machine made by the inventor are: the few working parts; the large wearing surface of the jaw N; the easy adjustment of the machine to crush coarse or fine; the free discharge of wet ore; the entire absence in the working parts of bolts, toggles, eccentric straps, rods, rubber springs, and numerous other complicated devices, which are a source of annoyance and expense in the ordinary jaw crusher.

There is a lug or projection at the upper side of the shoe, which prevents rock from being forced outward, when the cylinder approaches the shoe, the rock being held beneath this projection until it can be acted on and crushed by the movement of the cylinder. As the cylinder or its interior bushing turns loosely upon the shaft, it will be seen that the action of the cylinder will simply be to approach and recede from the fixed jaw without partaking of the revolving movement of the shaft.

There will be, however, a slight forward movement of the cylinder in the direction of the rotation of the shaft at each forward and backward movement with rotation to the die, so that the cylinder always presents a new force to act against the rock between the two, and will gradually complete the revolution.

These machines, which consist of three sizes weighing respectively 850, 1,900 and 2,700 pounds, are manufactured at the Fulton Iron Works, Fremont, Howard and Beale streets; office 220 Fremont street, San Francisco.

BOILER SCALE PREVENTIVE AND REMOVER. DOWNIE'S EUCALYPTUS PREPARATION.

Among the many troubles of the engineer and millman, is the growth of scales inside the tubes and boilers used in reduction and hoisting works; but about which not much complaint has ever been heard, for the reason that, not until recently, had any very effectual remedy ever been found for the same. As is well known, no boilers are so much subject to the formation of scale as those in use in the mining regions. This is owing to the fact that the water from the mines generally contains much lime and other foreign substances held in solution, that go to form scale in the boilers. In many of the mines boilers last but a short time—not more than a quarter or half as long as they do in San Francisco, for instance, where the water is comparatively pure. Anything, therefore, that will remedy this evil must necessarily be a

great boon to the mine owner as well as the engineer. It has been shown that it is as easy to heat through an inch of iron as through an eighth of an inch of scale. It is very plain, then, that with scale from an eighth to a quarter of an inch in thickness, the iron of the boiler must be heated so hot as to soon "burn" out, and a much larger quantity of fuel must be consumed. Thus are the expenses of a mine greatly increased.

Many remedies in the shape of "scale removers," "heaters," and "purifiers," have been tried, some of which have tended much to remedy the evil in certain cases. It was reserved, however, for a Californian to make the discovery of a perfect scale remover. George Downie, of Salinas, while experimenting on his boilers, which were very badly scaled, discovered that a preparation from the eucalyptus tree would do the work. Further experiments were made, and the results were so satisfactory that patents to secure the discovery were obtained in all the civilized countries of the world. The manufacture of the article was begun by the Downie Boiler Incrustation Preventive Company, of San Francisco, in 1883; and now the preparation is in almost universal use in California, and has come into great favor in the Eastern States and Europe. That it does good work is pretty well evidenced by the fact that it is practically the only scale remover sold on the Pacific Coast, where, a few years ago, there were a number in the market. The preparation, unlike most scale removers, contains no ingredients injurious to iron, as was shown by an examination made by Professor Hilgard, of the State University. It has been adopted by the United States Navy; and in one of the reports on the preparation, from the U. S. S. Ranger, appears the following statements:

"The eucalyptus preparation has been proven to protect the iron of the boilers from corrosion, comparison having been made between boilers in which the compound had and had not been used. On the surveying cruise of this vessel previous to this, similar in all respects, I found it necessary

at times to scale the boilers. The use of eucalyptus has obviated this necessity."

Judging from what has been said by the many who have used it, there seems no reason to doubt the claims of the owners of this article, that it is a thoroughly effective scale remover and preventative as well as a preservative of iron. Such being the case, it should be employed wherever impure water is used and scale forms in the boilers. The saving in the life of the boiler, in fuel, worry and vexation, will surely more than repay whatever the cost of the article may be.

MINING COUNTIES.

MINES PRODUCING BULLION OR IN COURSE OF DEVELOPMENT.

In further noticing the mines of California, the various mining counties of the State will be taken up in alphabetical order, this plan having the advantage of system and being the one adopted by United States Commissioners of Statistics and other governmental officials in dealing with the subject. In what is said about these mines it has been our purpose to notice only such as seemed to present some evidence of positive value, it having been, furthermore, our aim to avoid all exaggeration in our attempts at describing these properties. As much of our information has, however, been obtained through others, it may be that we have sometimes erred on both these points. It is not pretended that all the meritorious mines in the State have been described, or even so much as mentioned in this book, many such having escaped notice, for the reason that we were without accurate information in regard to them.

ALPINE COUNTY.

Alpine, beyond peradventure, presents the most unfortunate mining record of any county in the State, having returned comparatively little for the considerable sums that first and last have been expended in opening and outfitting her mines. Though liberally aided by outside capital this county has never produced over sixty thousand dollars per annum, the product of late years having amounted to scarcely half that much. Of the six or eight mills erected here, not so much as one has been kept steadily running. The towns built in the early day have gone to decay, the population of

the county, amounting once to four or five thousand, having dwindled to less than one. As the past of Alpine has been thus disastrous, so is her future by no means assuring, the ledges here, though numerous, and for the most part large and regular, carrying their ores, which are somewhat difficult of treatment, in streaks and pockets, while her forests, once a source of some wealth, have nearly all disappeared before the ax of the woodman. Not much can be said, of course, about a country that having received so much and been so long in process of development, has accomplished so little; though it must be admitted that there are some who still show their confidence in its mineral resources, by continuing their exploratory labors, carried on mostly by means of tunnels, for the construction of which the natural facilities are good. There is also much water power in the district available for the propulsion of machinery, with an abundance of timber still remaining in the Sierra not far away.

AMADOR COUNTY.

As Alpine occupies the lowest point on the scale of California mining counties, so is Amador entitled to be placed almost at its head. Traversing this county in a northerly and southerly direction is the great Mother Lode of the State, with another fertile belt lying to the east of it. On the Mother Lode occurs a series of important mines, of which the Plymouth Consolidated is the most noted. This property belongs to an incorporated company, much of the stock being owned by the Messrs. Hayward and Hobart, of San Francisco, who largely direct its affairs. This claim includes a linear extent of three thousand feet on the Mother Lode, and has been developed by means of shafts, stopes and levels to a vertical depth of fifteen hundred feet.

The reduction works here consist of two mills, carrying, the one forty and the other eighty stamps. They are both driven by water, the supply for the eighty-stamp mill being obtained from the company's ditch, which takes water from

the Cosumnes River, and for the other from the Amador Canal. These mills have capacity to crush about 250 tons of ore every day of twenty-four hours. The hoisting works are also driven by water. Great economy in operative expenses results from this substitution of water for steam. To guard against delay in case of accident, steam connections have been retained with the shafts, so that recourse to steam power could immediately be had if necessary.

The last Annual Report of this company makes the following exhibit:

| | |
|--|----------------|
| Gold bullion produced by the mines of this company for 1884.. | \$1,033,518 29 |
| Operating expenses..... | 331,163 84 |
| Profit | 702,354 45 |
| Twelve monthly dividends, of \$50,000 each, were paid, amounting to..... | 600,000 00 |
| Surplus over operating expenses and dividends..... | 102,354 45 |
| Add surplus on hand January 1, 1884..... | 44,559 96 |
| Total surplus | 146,914 41 |

The following account shows that little less than one-half of the surplus was expended on permanent improvements, principally in changing the motive power from steam to water. This outlay has added largely to the value of the property, and will effect a considerable reduction in operating expenses:

| | |
|---|--------------|
| Surplus..... | \$146,914 00 |
| Tyler ditch..... | 65 00 |
| Simpson ditch..... | 626 42 |
| Purchase of real estate..... | 210 00 |
| Construction of Simpson ditch reservoir..... | 1,343 14 |
| New tunnel on lode line, and development of Pacific claim.... | 4,853 49 |
| Purchase of real estate from Woolford..... | 6,007 84 |
| Construction of shaft on Woolford property..... | 2,654 87 |
| New works, shops, etc., and general improvement..... | 10,560 56 |
| Purchase of property, pipe, etc., and altering machinery; all in connection with change of power from steam to water..... | 46,298 03 |
| Total..... | 72,619 35 |
| Cash on hand..... | 74,295 06 |
| | 146,914 41 |

The operations of the year are described as follows.

During the year both mills have been run with regularity, crushing in the aggregate about 80,000 tons of ore. The average yield of gold was \$13 to the ton. Deducting from the operating expenses the value of material on hand, and unusual outlay in reconstructing Empire mill, etc., the cost of production is shown to be as follows:

| | Per ton. |
|--|----------|
| Cost of mining | \$3 20 |
| Cost of milling | 48 |
| | <hr/> |
| | \$3 68 |
| Add cost of saving and reducing sulphurets | 21 |
| | <hr/> |
| Total average cost | 3 89 |

Few large quartz mines in this or any other country are able to make a better showing than the above, these splendid results being largely due to the local management, which still remains in the hands of Messrs. Hayward and Hobart, the principal office of the company being in the City of New York, where a majority of the stock is owned.

The Seaton mine, at Drytown, owned by Messrs. Hayward & Hobart, is an early location, having been worked for many years with varying fortunes. Though much trouble has of late been experienced here in handling the water, this has finally been overcome, and the merits of the mine under the present ownership are being thoroughly tested. The property includes a well equipped 20-stamp mill. Adjoining the Seaton is located the Loyal mine, owned by a Boston company. This mine, also equipped with a 20-stamp mill, is in course of active development. Both these mines obtain water for driving their mills from the Amador Canal.

The Keystone mine, at Amador City, was located in 1850, and has been actively worked most of the time since. It has been opened by two shafts to a vertical depth of more than 1,000 feet, and by extensive drifts and levels run therefrom. The fissure here is 40 feet wide, a good portion of which is filled with pay ore, known to extend to a depth of over 1,000 feet. The 40-stamp mill of the company is kept

running steadily on \$14 ore, of which there is supposed to be enough in sight to keep it busy for the next five or six years at least. This has been a regular dividend paying mine for over twenty years, the gross annual product of late having been at the rate of about \$400,000 per annum. The mill here is driven by water obtained from the Amador Canal.

The Bunker Hill mine, at Drytown, though worked steadily for about twenty years still makes satisfactory earnings. The ore, of which there is a large quantity in sight, averages \$7 per ton besides the sulphurets which yield \$60 per ton. The mine is opened by shaft 700 feet deep, employs 70 men, and is outfitted with a 40-stamp mill, propelled by water bought of the Amador Canal Company. Contracts have been let for sinking the shaft 100 feet deeper, developments being here kept well ahead of ore extraction.

The Amador Queen mine is located in Hunt's Gulch, on what is known as the east vein of the Mother lode. The claim is 1,500 feet in length, and shows croppings the entire length. It has an incline shaft 205 feet in depth, with a cross-cut showing a ledge 27 feet in width; 500 tons of ore worked from this ledge yielded \$10.25 in free gold and 4 per cent. of sulphurets, which assayed \$120 per ton. Having obtained these results, the company put up a 20-stamp mill, which commencing operations in June, 1885, continued running till September, when they were compelled to close down, owing to lack of water. With the advent of the rainy season, the mill will resume work, and no doubt make good earnings in the future, as the mine is looking extremely well, there being ore enough developed to keep 60 stamps running. This mine has been worked since 1852, but to no great depth, owing to the flow of water. In 1880, Mr. James Morgan purchased several adjoining claims, making a total of 4,300 feet on the lode, and has driven a tunnel into the ground tapping the ledge 412 feet from the surface. During the past season about 900 feet of tunnel drifts have been run, the tunnel having cut several veins, varying in width from 3 to 21 feet. Two very fine chutes of ore have been

encountered carrying free gold and about 20 per cent. of arsenical sulphurets.

The owners of the Saint Louis mine, near Clinton, are crushing rock by arrastra process. They have a tunnel run about 100 feet into the hill, and have struck the ledge at a depth of 100 feet from the surface. The ledge is from 3 to 4 feet wide, and has paid an average of \$16 per ton. They can crush about half a ton per day, and are not prepared to work on a larger scale until they get it more fully opened up.

The Hardenburgh mine, situated at Middle Bar, which has been lying idle for many years, is believed to be a good property. It was closed down owing to litigation, but it is generally understood that work will soon be resumed.

The Gillick mine, near Volcano, continues to turn out immensely rich ore, which is accumulating on the dump, no crushing having been made as yet. The claim is owned by T. Gillick and Dr. Phillips, both working miners. They are cross-cutting at a depth of 80 feet, and have struck two quartz ledges, one from two to four feet wide, the other about 2½ feet, both of free milling rock of very high grade.

At the New York mine, a ledge of sufficient magnitude has already been developed to warrant the company in going to the expense of putting up a mill, and they have decided to do so without unnecessary delay.

The Mahony mine, which ranks among the early locations on the Mother Lode, after being worked successfully for many years, was at last closed down, owing to bad management and much litigation. After many futile attempts at resuscitating it, a party has at length contracted with the owners to put it in working order for one half the property. To rehabilitate the mine will cost about \$30,000; but it is thought the prospect will warrant the expenditure.

Tibbetts & Co. are opening up the Iowa mine at Sutter Creek, which is yielding considerable quantities of high grade ore, worked in a 5-stamp mill. A thin streak of the lode here will mill over \$100 per ton.

In the South Spring Hill mine, near Amador City, there

have been developed such large bodies of good ore that the company have recently doubled the capacity of their 10-stamp mill. The lode has been opened by shaft to a depth of 800 feet, at which point the ore body presents a very promising appearance.

The Lincoln is another of the early locations on the Mother lode, and for many years made an excellent record. Later on, the ore becoming of poorer grade, the mine barely paying expenses, was shut down and remained closed for a number of years. The 20-stamp mill is now being run again and under judicious management the mine is more than paying expenses, the outlook being, in fact, very encouraging. S. D. R. Stewart, who is operating on the south extension of the Lincoln, is pressing the work energetically. About 50 feet more remains to be sunk, and then drifting will be commenced. Existence of a body of good ore is known, and for this locality the present work is being directed.

The Pacific, in which the plant consists of mill and hoisting works, some very rich ore was struck last summer in the 1,500 foot level, which has been producing in a satisfactory manner of late.

In the St. Julian, which yields a fair amount of \$12 ore, a tunnel is about to be run to open up the deposit at a considerable depth below the present workings. Some very rich ore has been taken from this mine. Mill running.

The Zeile mine at Jackson was worked for many years with variable results, but never with any large success. About five years ago the late Dr. Zeile bought the property and equipped it with a first-class plant, consisting of a 40-stamp mill, hoisting and chlorination works, etc., whereby it could be worked extensively, effectively and cheaply.

The history of this mine since its transfer to Dr. Zeile is full of encouragement and instruction, as serving to illustrate the value of good management in the conduct of this business. The ore here is of low grade, yielding only about \$5.50 per ton—\$2.50 consisting of free gold, and \$3.00 being

extracted from the sulphurets. Not until recently has this class of ore been worked in California, its value having been first demonstrated by the operations carried on at the Zeile mine, where every gold and labor saving agency has been availed of and the strictest economy practiced in every department. The mill and hoisting works are run by water power, the source of supply being owned by the company. All the most improved modern appliances have here been introduced, such as rock-breakers, grizzlies, self-feeders, concentrators, etc. With these aids, even this low-grade ore is handled with a satisfactory profit, the cost of mining and milling the ore amounting on an average to not more than \$2.00 per ton. The ore body is extensive, having a width of about 35 feet, and a length of at least 900 feet on the 800-foot level, neither extremity having yet been reached. One hundred and twenty tons of ore are crushed daily, and much more might be disposed of without working the mine in an exhaustive way.

The Mammoth claim, at Middle Bar, has the reputation of being the richest gold-bearing mine in Amador County. The especially rich ore occurs in a small vein or stratum, and is mostly reduced in hand mortars, only that from the main ledge being worked in the company's mill, and even this is of very high grade. The rich ore consists of a peculiar black metal, much of which has yielded at the rate of \$5,000 per ton. This property was formerly owned by Mr. W. A. Nevills, who has disposed of one half of it, including the big tunnel, the Moor and the Settle Ranch mines to Chicago parties, Senator John P. Jones having also purchased a large interest in it. Mr. Nevills still retains a quarter interest in and manages the estate, which seems to have a great future before it.

The 10-stamp mill of the Modoc Company, Volcano District, has been running for some time past on ore that yielded over \$30 per ton. This ore can be taken out so easily that six men are able to extract enough to keep the mill running.

The Consolidated Amador, which, while in the hands of the original owners, made for many years a large and profitable production, has, since it changed ownership, met with many reverses, the result of ore impoverishment, fires and other misfortunes. The work of exploration has, however, been kept up with great persistence, and there is now a good prospect that the mine will once more, and it is to be hoped very soon, be restored to bonanza, as the drift being carried east on the 1,500 feet level, is penetrating virgin ground, of which there exists still a great extent in that direction. This company has proved the most indefatigable prospector in the county. The stockholders have been called upon to pay nine assessments of 50 cents each within a few years, without receiving anything in return. Still they stand up gallantly to the work with a perseverance that certainly merits success. During this long period of unproductive labor the employees have been paid regularly every month.

Important discoveries have been made in the Grover mine near New Chicago, which encourage the stockholders to believe that a return of the days of dividends is not far off. In running a drift west, at a depth of 450 feet from the surface, a large body of quartz has been struck. The ore is said to be of paying grade, and furthermore it is confidently claimed that it extends clear to the surface. The mill has been started to its full capacity of 20 stamps. A large force of men has been put to work, and everything betokens a long and successful career of activity for the mine.

BUTTE COUNTY.

Owing to many of the hydraulic mines having been closed by legal process, Butte has lost much of its importance as a mining county, quartz operations here having thus far been conducted on a rather limited scale. Some of the enjoined hydraulic miners have had recourse to drifting, but not generally with much success, the gravel deposits being too poor to pay for working by this method. A good many of

the drift mines proper are, however, paying tolerably well, a few of them, such as the Magalia and Indian Spring, quite largely. The former, which has a tunnel in 3,400 feet, employs about 40 men, and has yielded during the past four years at the rate of about \$75,000 per annum. The latter employs about 100 men, and the deposits, though not so rich, are much more extensive than the Magalia.

On Butte Creek are a number of small, unimportant mines, mostly drift. None of them employ over four or five men, and no new developments of any importance have been made of late. Most of these mines are what may be termed wages claims, and are not permanently worked. In the aggregate perhaps sixty white men and Chinese find intermittent employment in about half that number of claims, and produce from \$25,000 to \$35,000 annually.

The Chinese production for 1884, coming from the Lava Beds, Clipper Mills, Bidwell's Bar, Butte Creek, and river mining on a small scale, was about \$70,000.

At Cherokee Flat is located the extensive hydraulic mine of the Spring Valley Company, which for many years has been run on a large scale and with great success. This company have not been enjoined from operating, for the reason that they bought up some years ago all the farming lands exposed to be injured by the tailings from their mine. Owning this land, the company adopted a system of leveeing and reclamation whereby it has been, not only preserved from further damage, but a good deal of it has been rendered more valuable than it was before. In the purchase of this land, and in the construction of dams for the retention of the detritus, and of canals for conveying the waste water away, this Company have expended a great deal of money, not, however, without a good prospect of much of it being returned to them through the enhanced value of the land so protected and reclaimed. This mine is still producing a good deal of bullion, but not in such large quantity, nor yet with so much profit as formerly, as the banks here are getting high, causing a considerable increase in the waste material that has to be handled.

The Miocene hydraulic mine, near Oroville, after having been opened and equipped at great expense and in splendid style, commenced operations in 1881. After running for a few weeks it was closed by injunction and so remained until the spring of 1885, when it was started up again, and has since continued operations, the company having employed a hydraulic elevator whereby the debris from the mine is conducted into the pits already washed out, and there retained. Whether or not they will be permitted to go on disposing of their tailings in this manner, remains to be seen. This company tried drifting their ground, but found it too poor to pay.

A plan has been projected for working certain deposits in the vicinity of Oroville, which, if carried out, will probably prove successful. It consists in the construction of an irrigating ditch of a capacity sufficient to carry the entire flow of Feather River at low water from a point about two miles above Oroville. The water to be handled during the five summer months is from 40,000 to 50,000 miner's inches, which will be distributed over a large area of land in Butte and Yuba counties, now comparatively unproductive. Taking the water into the canal will make it possible to work several miles of the channel of the river, which is believed to be very rich. Also, it will be possible to drift in and bottom the deep gravels at Oroville, which the porous nature of the ground and the nearness to the river has heretofore made impracticable. These deep gravels are part of the channel of the Pliocene river which made the auriferous gravel deposits at this point.

Another and still more important enterprise has already been set on foot, and is now being vigorously prosecuted in this county. This is what is known as the Big Bend tunnel, which, when completed, will be over 12,000 feet long, and will carry the entire flow of the main Feather River, leaving thirteen miles of river bed exposed for working. The work is being energetically pushed, and the completion of the tunnel assured by July, 1886. Though a great outlay of

capital has been made, the expenditures have thus far been within the estimates, something unusual in the history of large engineering enterprises. In the tunnel seventy-five men are employed, in three eight-hour shifts. Machine drills operated by compressed air are employed, and give excellent satisfaction. The President of the company writes, under date of February 25, 1885: "Our tunnel was, on February 7, in a distance of 7,342 feet, leaving only 4,665 feet to be completed. At our present rate of progress, it will be finished by May or June of 1886. The tunnel is 9 feet high by 16 feet wide, and is deemed by competent engineers of sufficient size to carry the entire water of the river during the dry season."

Since February this structure has been advanced at the rate of about 350 feet per month, insuring its completion within the time fixed by the President of the company. As that portion of the bed of Feather River intended to be drained by this tunnel is known to be rich in gold, there is hardly a doubt but this enterprise will prove eminently successful.

COLUSA COUNTY.

The only mine of any note now being worked in this county is the Manzanita, situate on Sulphur Creek, and owned by Messrs. Burling & Co. This is a gold bearing ore, and tolerably rich, but so difficult of treatment that until recently it defeated all attempts made to work it. It is now being worked by one of the Wiswell Pulverizers and Amalgamators, a modification of the old Chile mill, which is said to perform its work in a highly satisfactory manner. The pulp, after passing through this mill, is run through one of the Morris concentrators, or gold savers, whereby the ore is made to surrender about 95 per cent. of the gold it contains.

CALAVERAS COUNTY.

Mining at Angels Camp, one of the most noted quartz districts in this county, has for several years past been espec-

ially active. Work has been commenced on many new mines, some of the old ones have been reopened, and a number of mills have been put up, two or three within the past year. The most of these mills are now running with remunerative results. Several arrastras are also being run on ore from the rich pocket veins that abound here. The 10-stamp mill on the Marshall mine is running with fair results. This mine has been worked for more than 20 years, and formerly yielded some very rich ore. The "Doc Hill" lode adjoining it, carries a streak of ore 3 feet wide, that will mill over \$100 per ton. Near by are the Gold Cliff and the Invincible mines, the former running 20 stamps, which crush an immense amount of low grade talcose ore. On the latter a 10-stamp mill and hoisting works have been erected. The mill is running and doing well. At Murphy's Camp, a like active state of affairs obtains. At Carson Hill, 4 miles southwest of Angels, is the Morgan mine, distinguished for the extremely rich ore taken from it in the early days. Next is the Reserve, with a 30-stamp mill steadily running, with the Stevenot claim near by, and from which a large quantity of excessively rich telluride of gold was extracted in 1854.

While quartz operations about Mokolumne Hill are somewhat depressed, the hydraulic and drift mines are being worked very actively, the former not having been seriously interfered with by the Anti-Debris Association. Recently some of the hydraulic miners, fearing injunctions, have commenced working their grounds by the drift process.

About West Point, where the lodes are generally narrow but rich, a number of mines are being actively and profitably worked, several of them crushing with the Huntington mill, which appears to give general satisfaction.

The Sheep Ranch mine, in the district bearing the same name, has paid continuously since its discovery in 1865, having well rewarded the original owners, though worked on a limited scale. Subsequently, it was sold to Messrs. Haggin & Tevis, who, having opened it up in a thorough and systematic manner, and supplied it with a first class

plant including a 30-stamp mill and powerful hoisting works, have since realized large profits from the investment. The vein belongs to the class technically called "kidney shaped," because of its great irregularity in size, the thickness ranging from 5 inches to 5 feet. The mine turns out about \$18,000 per month, the ore averaging \$20 per ton. The Harrington and Andrews mine, near Cave City, affords a large amount of fair grade ore, which is disposed of in a 20-stamp mill. New hoisting works have lately been put up here.

In the Mokolumne Hill District is located the Gwin mine, which has been worked to a depth of 1,500 feet, and for a number of years yielded largely, it being estimated that as much as \$3,000,000 have been taken from it altogether.

Work here was suspended several years since, on account of the inadequacy of the machinery to handle the ore and water, there being no probability of the resumption of operations in the near future.

The Lamphear mine, in Spring Gulch, has a 12-stamp water power mill. Shafts and levels have been run, the ore extracted yielding from \$6 to \$20 per ton. The mine is now idle.

At Rich Gulch are the Tiger, Foot and Thompson, and Anglo Saxon mines. The first mentioned has a 10-stamp mill. These have all been prospected with good results, but are now idle.

Active operations continue at the Hoosier Consolidated, near Whiskey Slide. Three tunnels have been run on the vein at varying depths, and a shaft sunk to the depth of 80 feet, developing a promising body of ore. There is a 10-stamp water power mill on the property, to which the quartz is conveyed down an inclined tramway, so arranged that the cars are operated automatically. The vein is from 2 to 4 feet thick, and yields from \$4 to \$10 per ton.

The Mount Smolus, in the same vicinity, has been worked to a depth of 350 feet. It has a ten-stamp mill and steam hoisting works, but is now idle.

Other quartz mines upon which work has been done, are the Mokelumne Hill, Bryan, White Swan, and the Quaker City.

Among the most important of the gravel mines, in the vicinity of Mokelumne Hill, is the Eureka, owned by the Cook brothers. There are two ditches connected with this mine, supplying 1,000 inches of water. The mine, worked on hydraulic principles, yields about \$60,000 per year.

On Tunnel Ridge are the Bonanza, Mammoth, and Penobscot hydraulics. About 400 inches of water are used in each, under a pressure of 100 feet. All are fairly productive. A mill has been erected on the Mammoth, for the purpose of changing the method of working from hydraulicking to drifting.

Among the more notable tunnel claims in the same ridge are the McCann, Green Mountain, Rough Diamond, and Contention. The Green Mountain and Rough Diamond have batteries for crushing their gravel, the former being one of the most remunerative claims in the county.

In Old Woman's Gulch are located the Empire, Safe Deposit, Three Ball, and Hartman claims, all worked through tunnels, except the Three Ball.

In Chili Gulch are the Star & Matteson, Duryea, What Cheer, Hughes, Bob Paul, Calaveras, and Sullivan claims. The Duryea, for years worked as a hydraulic, is now being drifted, a 5-stamp battery crushing the gravel. It is one of the best paying properties in the county. The Star & Matteson is worked through an incline. Thousands of feet of drifts, levels, breasts, &c., have been run, the gravel being crushed in an 8-stamp battery. The mill and hoisting works are run by water-power; a new incline is now being run. Work has been resumed on the What Cheer, by an incline in Stockton Ridge. Hoisting works have been erected for the purpose of freeing the mine of water and taking out gravel, operations being vigorously pushed, with good prospects.

The Kramer mine is located in Poorman's Gulch. A tunnel 1,500 feet in length was run through solid bed-rock

before gravel was reached, costing years of toil and thousands of dollars. Pay dirt is now being extracted.

The work of reopening the old Coffee Mill claim, near the Golden Gate Ranch, has lately been undertaken and operations will be urged industriously.

Other gravel mines not at present in operation, are the Boucher and Brackett, Excelsior, Concentrator, Pine Peak, South Star, and Happy Valley Blue Gravel.

Although a great deal of exploratory work has been done and several mills have been put up in Railroad Flat district, very little quartz mining is going on there at present, owing to the generally low grade of the ore. A good deal is, however, being done with the auriferous gravel deposits, which are of two kinds, surface and deep. The surface, being easy to work and with little expense, have been rapidly worked out, though the gravel deposits on isolated hills carrying gold will not be exhausted for many years. The deep gravel deposit underlying the lava formation is also extensive. Exploration has been prosecuted for years in search of the old river channels, and with encouraging prospects. The gold is coarse and of fine quality. All this stretch of mining land is supplied with water from W. V. Clark's canal, taken from the South Fork of Mokelumne River. This canal conveys the water along the highest practicable elevations, thereby giving the required head for hydraulic pressure for mining and mill power. Several hydraulic claims were in operation during the past year, yielding fair returns. Preparations are being made for more extensive work under the lava beds. W. V. Clark has up two powerful hydraulics, with the intention of drifting out gravel under the lava by hydraulic power. The water forced against the strata of gravel brings out the sand and stones in a flume sunk in the bed rock.

Most of the mines worked in the Glencoe District belong to the Glencoe Mining Company, who have on their grounds two mills, the one carrying 20 stamps, driven by water, and the other 18 stamps driven by steam, both of which have

been idle much of the time of late. Frittenbach & Co. are running a 5-stamp mill on remunerative ore.

Renewed activity is observable in the old San Andreas district, due in great part to the successful working of the Comet mine, situated two miles from the town, on the Calaveras River. The vein matter here is a species of talc interspersed with narrow strata of quartz, the whole carrying more or less gold. It is low-grade, but can be easily and rapidly crushed, and exists in large quantities. There exists here a ridge of this material, being almost identical in composition with that of the Gold Cliff at Angels, and the Reserve mine at Carson. The workings on the mine are represented by several shafts, tunnels and cuts, which afford good facilities for taking out ore. The company has a 20-stamp water-power mill for crushing this stuff.

Adjoining the Comet, and of the same general formation, is the Donallen and Hagerman mine. It has been profitably worked for several years, the ore being crushed in a 5-stamp mill.

The Gottschalk mine has a shaft 150 feet deep. But little work has been done upon it the past year, although with proper development it would undoubtedly prove a good mine.

The Bode and Wallace has produced some rich rock, but the vein is bunchy, and is not being worked at present.

The Rathgeb mine and mill, located near Lower Calaveritas, has been worked for years, and is productive.

Other important quartz mines in the district at present idle are the Pioneer Chief and Thorpe.

There are quite a number of productive gravel mines in the district, most of them being worked upon a small scale. Among the largest of the hydraulics are those operated at Worth's Hill and Pine Peak by Chinese. No special mention of these gravel mines is required, all having the same general characteristics. Aside from those mentioned, the productive mines are the Mexican, Campbell, Yankee Camp, Hedrick, Bennett, Solari, and Rancola.

DOUGLAS FLAT DISTRICT.

The mines in this district are exclusively gravel, and comparatively few in number.

Among the more prominent claims is the Ohio, a mine that has been successfully worked for years by sluicing, and employs four men.

The Rising Sun, a claim recently opened, has four shafts varying from 30 to 120 feet in depth. It is now being worked from a tunnel.

Other mines are the Take What's Left, Texas, Wild Goose, Thomas, Spiritual Resort, Duck Bar, Fairview, etc.

At Batchelor's Valley several shafts have been sunk and tunnels run with such good results that some parties are about opening a hydraulic here.

In and around Vallecito there is but little in the way of mining going on. Several important enterprises are talked of, but operations have not been commenced. This district is soon to be supplied with water, which will greatly increase its production.

The Copperopolis district, once so famous for its copper interests, has now but little to boast of in the way of mining. The Union and Keystone copper mines, which twenty years since were supplied with extensive machinery and gave employment to hundreds of hands, are still idle with no immediate prospect of a resumption of active operations. These mines are now in the hands of Boston parties, who simply keep the machinery in order. It is doubtful if, at the present price of copper, work will be resumed. There are but few quartz mines in this district.

The Meritus mine has a Huntington mill, capable of crushing 15 tons of quartz per day. The vein averages about 3 feet in thickness, and is reported to be paying well.

A number of this style of mills are now running in this county, and are said to afford general satisfaction, being both cheap and efficient. The Pine Log and the Royal quartz mines are running each a 10-stamp mill, and paying

well; also the Hilltop, where the ore is crushed in an arrastra. The Pierce gravel mine, under the Table Mountain at O. Byrnes' Ferry, on the Stanislaus river, continues to pay well.

Not much is now going on in the old Campo Seco district, one cause of the depression that has prevailed here of late being scarcity of water, a trouble that promises to be partially remedied through the enlargement of the reservoir of the Calaveras Water Company, in Salt Spring Valley, which has lately been so extended that it covers now an area of 2,000 acres. From this reservoir a ditch 16 miles long carries the water to the companies' hydraulic gravel lands, embracing 600 acres, on which operations are conducted with varying results.

DEL NORTE COUNTY.

Most of the mining carried on in this county consists of hydraulic, river-bed and the various other forms of placer operations. The most extensive and valuable hydraulic mine in the county is that belonging to the Del Norte Gravel Mining Company, situated on Hurdy Gurdy Creek, at a point about 30 miles easterly from Crescent City, and which, being fully described further on in this book, need not be further spoken of here. It may be stated, however, that since the description mentioned was written, the production made by this property has enhanced still further its reputation as a bullion producer. This mine is situated on the westerly slope of the Siskiyou mountains in the basin drained by Smith river and its confluent, on several of which there have been in former time rich placer diggings, and along which there are still valuable hydraulic deposits.

The greatest number of hydraulic claims, however, is being worked along the Klamath River, on which, as we go up stream, are situated the following claims, all of which are actively worked during the water season, lasting generally from about December to August, though in some instances it extends throughout the year: Bunker Hill, Rood,

Wingate Hill, Happy Camp, Richardson and Mucamuc. The Bunker Hill ground has been worked for nearly thirty years, paying liberally all the time ; most of the others having been worked from 15 to 20 years, with equally good results. The Rood claim, not until recently opened and equipped in good style, is capable of being worked nine months in the year, and is considered a valuable property, for the money invested in it. The Happy Camp ground, formerly owned by Horace Gasquet, but lately purchased by W. J. Smart, comprises several hundred acres of auriferous gravel, the most of which it is thought will pay well, worked by the hydraulic process, for which the facilities here are excellent. The Richardson claim, situated one mile above the town of Happy Camp, and on the opposite side of the river, shows as good a record, length of time considered, as any other mine in the county, having for 15 years past produced from thirty-five to fifty thousand dollars per annum, more than sixty per cent. of which has consisted of net profits.

Several quartz claims in this county are being worked with fair success, that known as the Bald Hills mine being rich in free gold. In the summer of 1885, a number of very promising quartz ledges were discovered near the head of Coon Creek, since which time several of them have been thoroughly prospected and found to be of large size, the ore carrying from twenty to thirty dollars per ton in silver, with some gold.

The black sands along the ocean beach in this county, were formerly worked on a large scale, and for a number of years afforded a thousand men or more, good wages. When the richer portions of these deposits were worked out they were abandoned. This being when men would not work for less than three or four dollars per day, makes it probable that two or three dollars per day could still be made working these beach placers, and with the improved methods now in use, possibly more.

In addition to the magnitude of its auriferous deposits, the county possesses other inducements to the prosecution of placer mining in the abundance of wood and water, and in the immunity from possible litigation on the *debris* question, due to the peculiar conformation of its rivers and an absence of farming lands along them. There are also chrome iron mines in this county carrying both gold and silver. The deposits of chrome iron are numerous and very extensive. The Tyson Company of Baltimore, Md., is the only one now prosecuting any work in this branch of mining. The abundance of this metal in other places, where cheap labor and transportation favor its production, has prevented any extensive mining for it in this county, but with better facilities these mines must sooner or later become prominent sources of supply, as the ore is good and the quantity in sight, even in its undeveloped state, is large.

Copper ore is found in many places in the county, but nothing at present is being done with it.

Near point St. George the indications of coal have for many years past been sufficient to keep up an irregular search for veins, which until the latter part of last year has been attended with poor success, but borings of late have given promise of better results and a coal bed has been found. Its extent can only be shown when more fully developed.

EL DORADO COUNTY.

A steady revival of quartz mining has been going on in this county for a number of years past. In the early prosecution of this industry such mistakes were made here, generally the results of inexperience, as tended to bring the business into disfavor. Latterly, however, these mistakes are being corrected or avoided; hence the improvement mentioned, there being many really good mines in the county, a considerable number of which, under more thorough and systematic development, are yielding handsomely, while still more show encouraging prospects.

QUARTZ MINES OPENED AND MILLS RUNNING.

The following constitute the principal quartz mines in this county that have been more or less developed, and that have now or recently had mills running on their ores:

On the Grand Victory mine, located near Diamond Springs, a 50-stamp mill, very complete in all its appointments, was put up five years ago the present fall. Since its erection this mill has been run almost constantly, its operations having suffered occasional interruptions from scarcity of water. The ore, which is taken from an open cut, is said to be worked at a total cost of 65 cents per ton—25 cents for mining and 40 cents for milling; 225 tons being passed through the batteries daily. If these figures are correct, to the management of the Grand Victory belongs the distinction of working this class of ore more cheaply than is being done any where else in California. But the quartz here must be unusually soft, as is evidenced by the large quantity put through the mill, which is equipped throughout with all the modern labor-saving devices. Among other improvements introduced here is the Morris canvas-lined sluice, especially well adapted for saving both the sulphurets and the free gold. This useful invention has met with the approval of millmen wherever used. Though of extremely low grade, the ore body in this mine is of vast proportions, the facilities for extracting it being at the same time exceptionally good. Good judges have expressed the opinion that there is ore enough here to keep a 50-stamp mill running for fifty years, and most likely for a much longer time.

To the 5-stamp mill of the Crystal mine five more stamps were added in the month of July last, the mill having at the same time been supplied with two Frue concentrators. The machinery here is driven by water introduced through a 16-inch pipe and discharged on two Pelton wheels, one for operating the stamps and the other the concentrators. This mine, which is situated about one mile north of Menden, in Mud Springs Township, is under the management of L.

L. Alexander, an experienced miner and capable business man, who has put it in excellent shape both as regards ore extraction and ore reduction. The ore is taken out through a tunnel driven to the lode and giving two hundred feet backs. This lode is of good size and carries a fine body of high grade ore. From the tunnel a lateral drift is being run to prospect the Creole ledge which crops out near the Crystal, and is said to be marked by good ore indications.

The Mount Pleasant mine, at Grizzly Flat, employs about 30 men and keeps its 20-stamp mill running steadily, as it has for many years past, making at present a monthly production of \$15,000. This mine was worked as early as 1852, and for a time with some profit; but owing to inexperience at the business and a faulty management, was afterwards abandoned. Later, however, with a better management and the improvements introduced, it began to pay, and was finally worked into one of the best mines in the county. There is a good body of ore in the mine, the ledge being seven feet wide at a depth of 630 feet below the surface. There is no waste here, all the ledge matter being put through the mill. On the 400-level drifting has been extended on the ledge 954 feet. The vein grows larger and carries its gold in depth. Though the ore is not high grade, with the facilities at hand for working it, Capt. I. H. Smith, the Superintendent, has managed to make the mine pay steady and satisfactory net earnings. The mill, which is driven by water, is a model of its kind; having been equipped with special reference to efficiency and economy. For saving the sulphurets, which form a valuable part of the ore, eight Frue concentrators have been placed in the mill.

The Slate Mountain mine keeps 20 men and a 5-stamp mill, steadily and profitably employed. It is being carefully worked and shows signs of being a good property. Though opened but a short time it has already paid for all improvements, mill included, and reports a surplus on hand. The lode, which is tapped by a tunnel 100 feet below the

surface, varies at that point from one and a-half to three feet in width, the whole of it consisting of ore that will mill twenty dollars per ton. From this level a winze has been put down 100 feet, all the way in ore. This mine is owned by Messrs. Zombro, Jordan and Benjamin. During the earlier stages of its development this property was under the superintendence of Daniel Monkton, an experienced and capable mill builder and miner, to whose skillful management its present success is largely due.

The Springfield, formerly known as the Church Union mine, having, seven or eight years since, passed into the hands of Messrs. Hayward & Hobart, of San Francisco, the new owners proceeded at once to explore the lode with thoroughness and system, in the prosecution of which work, a body of fine ore was developed. This accomplished, a first class plant was placed on the mine, consisting of a 15-stamp mill and hoisting works, water for running which is bought from a company owning a ditch in the neighborhood. So thoroughly equipped and in such capable hands, this mine is making good earnings, and promises to become one of the most valuable properties in the county.

The Union mine, on Webber Creek, under the Superintendence of Mr. J. S. Wall, has been opened by shaft to a depth of nearly 200 feet, sinking to go on till a depth of 300 feet is reached. No cross-cutting has been done, ore enough to keep the 10-stamp mill steadily employed having been obtained without. As this mill is well outfitted and driven by water, it costs but \$1 per ton to work the ore here, cost of mining being \$2 per ton. The mill crushes 20 tons per day, the ore being of good grade. But 12 men are employed altogether—8 in the mine and 4 in the mill. This mine was opened in 1884, and two shafts sunk, each 100 feet; 150 feet of drift were run, hoisting works put up, roads built and a tunnel run for a distance of nearly 500 feet. The outlook here is excellent.

A large and good looking quartz lode, having been opened up in the Eureka mine at Georgetown, the owners, in the

early part of 1884, put up a 10-stamp mill with all modern improvements on the property. Starting out with what is known as the Tasker Concentrator, made in Philadelphia, these machines proved so utterly worthless that they had to be thrown aside and others substituted in their place. The hoisting here is done by steam power, though the mill is driven by water. The shaft is down several hundred feet, a large body of fine ore carrying much sulphurets, having been developed. The mill crushes about 25 tons of rock per day, and is understood to have made such satisfactory earnings that its crushing capacity is to be increased.

On the Alhambra mine, near Spanish Flat, Kelsey Township, a 5-stamp mill was built in the summer of 1884, and has been running most of the time since on a class of ore that is said to have averaged nearly \$30 per ton. From small quantities of rich ore selected here, \$20,000 have been pounded out with a hand mortar. The vein, though small, is rich, and the quartz being much decomposed, is easily crushed. The property is in charge of Mr. R. H. Redd, who is managing it in a thoroughly business like way.

The Gopher-Boulder mine, in Coloma Township, having passed under the control of an Eastern company, has been put in shape to keep the 20-stamp mill, erected upon it in 1884, steadily running, it having been operated successfully since it was started up in the month of February last. The mill being a good one and the ore of fair quality, the property promises to prove a paying one for the future.

The Zentgraft quartz mine, at Wild Goose Flat, yielding more pay ore than the present 5-stamp mill can dispose of, its crushing capacity is about to be doubled. The lode opened up on the 100-foot level for 700 feet, shows a width of three feet for the whole distance. A tunnel has been run from the mill into the ledge, through which the ore can be brought out and taken directly into the feeding room, whereby a saving of \$1 per ton over the former plan of handling has been effected. Mr. Zentgraft and his son have shown a commendable industry and perseverance in the manner

they have for years, and under many discouragements, carried on the work of developing and outfitting this mine, which seems likely now to bring them an ample reward.

The Cherokee Flat mine, four miles from Greenwood, carries a vein varying in width from two to twenty inches, that mills \$300 per ton. A drift on this vein 250 feet shows ore all the way. A parallel lode 60 feet wide mills \$6 per ton. A 3-stamp mill has been put up here to work the rich ore from the small vein.

On the Rosecrans' mine, situated $3\frac{1}{2}$ miles southwest of Georgetown, a 10-stamp mill was put up several years ago, and has been running with some interruptions since. Both the mill and hoisting works are driven by steam. The mine is opened by a shaft 200 feet deep, from which levels have been extended for 600 feet. The ore crushed is reported to have yielded between \$15 and \$20 to the ton.

The Melton mine, at Grizzly Flat, is owned by an Eastern company, who have put up a 15-stamp mill and hoisting works, and are exploiting the lode in a very thorough manner by means of a series of tunnels, driven the one below the other. The lowest of these tunnels, No. 5, will, when completed, drain the mine to a depth of more than 600 feet. These tunnels are being excavated with power drills. The mine could not be worked through the shaft put down, owing to the large amount of water made. A good deal of ore has been milled here, all of fair grade and some very rich. The superintendent, H. H. McClellan, is carrying on the work with energy and good judgment, and the prospects of the mine are considered first-rate.

The 5-stamp mill erected about one and a-half years ago on the Revenge mine, near Greenwood, has been running successfully since, making money for its Eastern owners. The ore yields only about six dollars to the ton, but there is a good deal of it, while the business of extracting and reducing it is carried on with economy and good judgment. The mine is under the direction of F. R. J. Dixon, the mill being operated by his son, William H. Dixon, a practical millman and amalgamator.

A 10-stamp mill completed last summer, has since been running on the Teaffe mine, situated on Webber Creek.

On the Spanish Creek mine, owned by Joseph Ganiblin, a 5-stamp mill was put up a little over one year ago, and is reported to have been running since on pay ore. The lode here which is about three feet wide, prospects fairly, and is being opened up with skill and care.

On the Pyramid mine, nine miles west of Placerville, a 15-stamp mill was put up some years ago, but the ore paying only about \$3.50 per ton, and nothing being then known about the value of sulphurets, work was suspended. A little more than a year ago other parties getting possession of the property, a 5-stamp mill was built here which has since been crushing the ore at a profit. The mill and Frue concentrator are run by a hurdy-gurdy wheel, and there is a talk of increasing the crushing capacity as there is plenty of medium grade ore to be had here. The lode, over forty feet wide, is opened by an 8 x 12 foot shaft, sunk in the middle of it.

The Independence mine, on the Consumnes river, was last year purchased by an Eastern company, who repaired the old mill belonging to it, and afterwards uncovered a 3 foot lode, carrying \$20 ore, of which they have since had enough to keep the mill busy. Indications here point to a good mine.

The Lamphier mill has been running on very rich ore. The incline in the mine having reached a depth of 245 feet, drifts have been carried from it, both to the north and south. In the south drift, the vein is narrow, only about 15 inches wide, but exceedingly rich. In the north drift, it is of much greater size but poorer.

The 4-stamp mill on the Oro Fino mine, not long since discovered, has been run on \$10 ore.

THE GREEN STONE BELT.

Along what is known as the greenstone belt, which, commencing in Amador County, runs across El Dorado in a

northerly direction, prospecting has been carried on actively for the past two or three years, and generally speaking with gratifying results, a number of promising mines having been developed here. On some of these, substantial hoisting works have been erected, and there is little doubt but crushing mills of suitable capacity will follow at an early day.

PLACER OPERATIONS.

There is now but little placer mining other than drift being carried on in El Dorado County. In the winter, some of the flats and gulches continue to be worked by hand or ground sluicing, mostly in a small way. Not much is now done in the way of river bed operations, the little attempted in that line being mostly done by the Chinese. Hydraulic mining here has ceased, having been stopped by legal process. While the greater part of the gravel taken from the drift claims is washed in sluices, some of it is so impacted that it requires to be pulverized with stamps and treated after the manner of quartz, there being some ten or twelve mills in the county engaged in crushing this material.

The Green Mountain and the Alderson drift mines, near Placerville, have each a 10-stamp mill, for crushing the gravel taken out. These mills are driven by water, running when they have water for the purpose. The Benfeldt drift mine, near Smith's Flat, has also a 10-stamp water-driven mill for gravel crushing, the material being hoisted by water power up a 700 foot incline. This mine has been paying well for a number of years past. The Elf Company at Prospect Flat are running a 10-stamp mill on gravel from their drift mine, and doing very well, there being five or six more mills of this kind in the county, some of which are run steadily and others only a portion of the time.

SEAM DIGGINGS.

In this county, located mostly in the vicinity of Georgetown and Greenwood, are found the peculiar deposits known

as "Seam Diggings," consisting of numerous thin seams of gold bearing quartz, lying near and generally parallel with each other, though they sometimes interlace; and which, occurring in a soft slate, and being much decomposed, can for the most part be broken out with the crowbar and pick, supplemented sometimes with a little powder. When broken out this material is washed in sluices or by the hydraulic process, the harder quartz being collected and crushed with stamps. Only in El Dorado do "Seam Diggings" proper much abound, nor do they prevail here to any great extent, except in the localities above mentioned.

These veins or seams, which are from half an inch up to three or four inches in thickness, have a northwesterly strike and a northerly dip—their distance apart being from one to six or eight feet. In working these claims open cuts are run into the hill where they occur, some of these cuts being two or three hundred feet long and from fifty to one hundred and fifty feet wide, there being within this space all the way from fifty to one hundred of these small gold bearing seams; the most of them, especially the smaller ones, being very rich.

These open cuts are for the most part excavated with the hydraulic pipe. Shafts sunk at the inner extremities of these cuts generally show a continuation of these seams downwards. Working these diggings where the conditions are favorable, is apt to be a profitable business.

NEVADA COUNTY.

As a bullion producer, Nevada has from the first outranked every other county in the State, Amador having of late years come next, with Placer and Sierra not much behind, the spurt in Mono a few years ago having been of short duration. About every form of gold-bearing deposit found in California occurs in this county, and generally in marked strength. The quartz lodes here are numerous, many of them large, a considerable proportion of the whole being

well stocked with ore. Here the "Dead Rivers" that constitute the principal sites of drift mining are found in their best state of preservation, and here the hydraulic banks reach exceptionally large proportions. Nevada is also noted for the number of its quartz mills, ditches, reservoirs, etc., the three reservoirs belonging to the North Bloomfield, the Eureka Lake, and the South Yuba companies, having a containing capacity of more than four billion cubic feet of water. Quartz mining in California had its origin in this county, having been commenced here as early as 1850, since which time it has been steadily pursued, making the while such gains as have advanced the business to its present state of perfection. Over four million dollars in gold are produced annually in this county, besides \$60,000 in silver, obtained by working the sulphurets by the chlorination process, there being no mines worked here for silver alone.

During the past few years, water has been largely substituted for steam as a motor, thereby greatly reducing the current expenses of running the mills. The rivers that skirt and the many large ditches that traverse the county, afford much water that can now be easily made available for the propulsion of machinery.

PRODUCTIVE QUARTZ MINES.

The following are the principal quartz mines in this county that are making a bullion production from ore worked in their own mills: The Idaho, situated one mile south from the town of Grass Valley, has been run without cessation for many years past, having made a total production of about \$7,000,000, of which over \$3,000,000 have been disbursed to the shareholders in dividends. The payment of dividends commenced in 1869, and has since been intermitted for a period of only five months, in 1883. From the seventeenth annual report of Mr. Edward Coleman, superintendent, we gather the following particulars in regard to the condition and operations of the mine during the year 1884,

which appears to have been much more prosperous than the preceding year: In 1883, the total product of the mine was \$364,599.50, which gave dividends only to the amount of \$34,100, while for 1884 the product was \$561,895 49, and the dividends \$271,250. The average value of the ore for the year was also higher, having been \$18.04 per ton as against \$12.76 per ton in 1883, and the cost of milling and mining was \$7.86 per ton, whilst in 1883 it was \$8.71 per ton. There were 31,143 tons of quartz crushed in 1884, an excess of 3,000 tons over the preceding year. During the year the 1,400-foot level produced the principal part of the quartz extracted. The 1,500 level has been opened, but the regular pay chute is not yet reached. The incline has been sunk 119 feet below the No. 15. The introduction of water power for general operations has effected a large saving over the use of steam, estimated at \$30,000 for the year. The mine is looking well, and as no further extraordinary expenses are anticipated, such as were encountered in 1881, dividends for the present and for some years to come are assured. The stock of this company is owned mostly by a few parties, the Messrs. Coleman Brothers, John and Edward, of Grass Valley, and Mr. George D. McLean, of San Francisco, being the largest shareholders. These shares have never been on the stock market, nor have more than a very few of them ever passed from the hands of the original holders. The history of the Idaho mine has, in short, reflected great credit on the managers, who have conducted its affairs from first to last on the strictest business principles. The notable success here achieved, has been due, in fact, not more to the inherent merits of the property than to its supremely good management. During the present year, there has occurred here a manifest improvement in the quality of the ore, and there can be little doubt but the Idaho will continue in bonanza for many years to come. The mill of this company carries 35 stamps, driven by water power obtained from the South Yuba Ditch, and discharged under a pressure of 542 feet, affording ample power to drive both the mill and the

hoisting works. The mine has now been worked to a vertical depth of 1,500 feet, at which level the ore body shows as much strength as at any point above, though the ore is not of quite as high grade as formerly. The cost of mining the ore here averages \$7.86 per ton, cost of milling being \$1.70; 220 men are employed in the mill and mine, all white; no Chinese have ever been employed by this Company. The wages paid are \$2.50 per day for shovelmens, mill hands, etc., and \$3 for underground workers, foremen, blacksmiths and other mechanics receiving extra wages. There has never occurred any trouble here on the wage, the hour, or any other question between employers and workmen. Concentration is effected here with the Cornish buddle, though the Messrs. Coleman say they would, were they about to build a new mill, be likely to put in the Frue Concentrators.

The Empire mine, situated about two miles southeast from Grass Valley is one of the earliest locations made in the district. For many years it was worked with variable results. Latterly having the benefit of a very efficient administration, it has been run with a uniform and marked success, ranking now among the most promising properties in the vicinage. The main incline shaft is down in this mine to a depth of 1,500 feet, from which level drifting is being carried on. The ledge at this depth is $2\frac{1}{2}$ feet wide, and shows well in both free gold and sulphurets. A vertical shaft is being sunk to intersect the present incline at a depth of 2,000 feet. The Empire is being worked by a large force of men, ore being broken out in all parts of the mine.

FRESNO COUNTY.

Although some gold mining has been carried on in this county ever since 1851, it has always been noted more for its agricultural than for its mineral resources. The limited placer deposits found here having been exhausted, attention has, for a number of years past, been turned to quartz min-

ing, which business, without being very actively or extensively pursued, is still quite prosperous in several localities.

The principal mineral districts are the Potter Ridge, Quartz Mountain and Fine Gold, all situated in the eastern part of the county, the central and western parts consisting mainly of agricultural lands.

The first mentioned of these districts, and the most important of the series, lies some sixty miles northeast of Fresno City. The metalliferous belt here, which runs north and south, has a length of six or seven by a width of four miles. A Huntington and a Redstone mill, put up here last year, have been running most of the time since, and are reported to have done tolerably well. The mass of the ore being, however, low grade and somewhat base, will require treatment by a different mode of reduction.

In the Fine Gold district, where the mineral belt is about four miles wide by eight miles long, the ores, though of the same general character, are much richer than in the Potter Ridge district. Two stamp mills and a Huntington crusher put up here, have been run with moderately good results, the ore having averaged over \$20 per ton. From the Hildreth mine, in this district, a quantity of exceedingly rich quartz was taken out last summer. It came from a depth of 240 feet, and the deposit has not yet been exhausted. This mine promises to be one of considerable value.

The principal mining operations in the Quartz Mountain district are being carried on by a French company, who, within the past year, having purchased there extensive mining properties, are proceeding to develop and improve the same in a thorough and intelligent manner. Their quartz interests comprise a number of different lodes, some of which have been pretty thoroughly exploited, and show large bodies of good ore. On their main vein they have run an incline to the depth of 240 feet, at which point a fifty foot drift on each side of the incline shows a nine foot vein of ore that pays over \$15 per ton. They have some six hundred acres of patented ground, and will undoubtedly reap

an abundant harvest when their extensive works are completed and actively employed. A 60-stamp mill has already been put up, and another of equal capacity is to be built when their ditch—which is to supply motive power—is finished. The construction of this ditch is in active progress, most of the earth and rock excavation having been finished last winter. It was a work of great magnitude, and its completion in so short a time through the rugged country over which the line passes, was a matter of surprise to those conversant with the great difficulties to be surmounted. The line of the ditch is a fraction over twenty-one miles in length, and traverses a section of country rugged and precipitous, is covered, besides, with a dense growth of chaparral, which required to be hewn to the ground before the grade line of the survey could be established. There are three tunnels on the line of ditch, the aggregate length of which is 573 feet. The maximum grade of the ditch is twelve feet per mile, and the minimum is six feet per mile. The capacity, roughly estimated (allowing a reasonable margin for loss in leakage and evaporation), is about four thousand miner's inches. Appurtenant to this ditch is a valuable water franchise, covering six thousand inches of the flow of the San Joaquin River.

In addition to the foregoing improvements this company have constructed roads, built shops, and all needed houses for the accommodation of their employees, besides performing much miscellaneous work necessary in the prosecution of an enterprise of such magnitude. They have from the commencement of operations kept about 100 men in their employ, which number will probably be increased in the future. The expenditure of so much money and the employment of so much labor, has greatly improved business in the eastern part of Fresno, and even stimulated it not a little throughout the entire county.

In addition to the arrastras mentioned, there are five or six different companies in this county who are running quartz mills on ores from their own mines. On the Last.

Chance mine, owned by McKinney and Rule, a 10-stamp mill has for the past year been crushing \$20 ore, of which the mine seems to contain a great deal. The Surprise mine shows at a depth of 200 feet a six foot lode that mills \$18 per ton, with about 3 per cent. of sulphurets, worth \$300 per ton. The 5-stamp mill of the company turns out gold bullion to the value of \$10,000 per year, on which a fair net profit is realized; the Gambetta, 1,200 feet north of the Surprise accomplishes about the same results. The Fresno Enterprise mill, the Hawkeye, and the Texas Flat mills, each five stamps, have been running steady of late, making satisfactory earnings.

Quite a number of arrastras are being run in this county, on ore that yields from \$50 to \$100 per ton ; some of these machines being propelled by steam, and others by horse or water power.

There are both gold and silver-bearing deposits in Fresno, the latter occurring mostly in the Mount Raymond District, situated five miles above the Big Tree Station on the Yosemite route, and named after Dr. Raymond, the distinguished *savant*, and late United States Commissioner of Mining Statistics. The mineral formation here extends along the range from five to eight miles and seems to be practically inexhaustible. Some of the ore assays sixty per cent. of lead, besides paying quantities of silver, while the ore from other mines assays from \$75 to \$125 to the ton in silver and contains but little lead. The country rock is mostly limestone and porphyry. The ores are galena. A test shipment made to the Selby Works, at San Francisco, returned \$50 per ton in silver and 55 per cent in lead. A great many locations have already been made in the district, which if a tithe of what is reported about it be true, must soon attract wide attention. Though lying at a considerable elevation, this district is quite accessible and well supplied with wood and water.

HUMBOLDT COUNTY.

Humboldt as first formed was almost wholly an agricultural and lumber making county, containing within its limits no important gold bearing deposit, except the original Gold Bluff. Through the reconstruction of the northwestern group of California counties, which took place several years ago, and through which Klamath County was extinguished, her territory having been apportioned amongst her neighbors, Humboldt became in a larger sense a mining county, including now within her boundaries the left bank of the lower Trinity river, and a sweep of the Klamath, where it makes a long detour to the south. The mines along these streams consist mostly of placer deposits, though there are here also some quartz lodes, none of which have, however, been as yet much developed. Nor are the placers of much importance, so far as actual production goes, though some of them are being worked in a small way mostly by the hydraulic process. The value of the gold dust gathered here amounts probably to \$300,000 per annum, a fourth of it being taken out by the Chinese from the river beds. The Gold Bluff mines, which constitute by far the most important auriferous deposits in Humboldt, are fully described in an article found further on in this book.

INYO COUNTY.

Owing to the vast number of mining locations that first and last have been made in this county, nothing like a detailed description of more than a few of the most important of them will here be practicable; as, indeed, the comparatively small amount of work that has been done on these claims renders any such description wholly uncalled for. Inyo comprises within its limits an immense extent of metalliferous territory, and, although the work of exploration was commenced here at an early day, very little has yet been done towards the development of her varied forms of min-

eral wealth, owing to the unfavorable conditions under which this work had to be carried on. Besides being a long way off, the Sierra Nevada interposed an almost insurmountable barrier between this section of country and San Francisco, its principal point of supply. The hostility of the Indians presented another, and for several years, very formidable obstacle to the exploration of that region; and, finally, when population began to pour into it and capital came to its aid, everything was conducted with such a reckless disregard of business sense that only loss and disaster attended nearly every enterprise set on foot there. These mistakes were followed by the usual consequences; work upon the mines ceased; the mills and furnaces were closed down; the people left and the whole country received a set back from which it has only now partially recovered. What has tended more than anything else to bring it up again, being the construction of the Carson and Colorado Railroad, which now not only connects Inyo with the general railroad system of the country, but traverses the county centrally throughout nearly its entire length. The advent of the railroad has proved, not only a signal for the revival of mining enterprise in that distant section of the State, but it has tended to restore confidence in its mineral resources as well, both the moneyed and the general business community having regarded it for the past year or two with increased favor. If now the wasteful expenditures and the other follies committed here six or eight years ago shall be avoided and a strictly business course be pursued in the conduct of mining affairs, it may reasonably be expected that Inyo will soon come to enjoy that large share of material prosperity to which her immense mineral resources entitle her. Already work has been resumed on a good many of the mines there. Some of the reduction works, that had long been idle, are running again; population is increasing; labor is in greater demand; new strikes are reported here and there; ore in considerable quantity has been shipped of late to the Selby Reduction Works, and it is now well established that the

bullion product of the county will be somewhat larger this than it was last year.

KERN COUNTY.

The only placer diggings of any extent ever found in this county, were those along Kern River, discovered in 1854, and which caused at that time what is known as the "Kern River Excitement," during which some thousands of miners visited that locality. The deposits, however, proved very disappointing, being neither rich nor extensive. They were worked out in the course of a few years, after which the auriferous quartz veins, quite numerous in that section of the State, were attacked and worked with variable results. The small veins, of which there are many about Tailholt, Havilah, in Kelso Valley, and in the Long Tom and some five or six other districts organized in different parts of the county, have for many years past been worked in a limited way, only small stamp mills and arrastras being in use. The ore, as a general thing being rich, the miners here have been able to make fair wages, though the total product of the county has never been large, not exceeding \$300,000 per annum. There are in this county twelve quartz mills, carrying an aggregate of 188 stamps, the number of arrastras being perhaps twice as many.

The reputation and mining interests of this county were seriously damaged by the disastrous failure of the 60-stamp mill put up several years ago on the Big Blue ledge at Kernville, the large body of ore here proving to be of too low grade to be worked with any profit. An English company is reported to have bought this property with a view to crushing the ore in the costly mill erected upon it. Should the attempt prove successful, it would do much towards restoring confidence in the mines of this county.

A little over one year ago a number of very promising gold bearing lodes were discovered in the eastern part of Kern County, and at a point about forty miles easterly from

the Mohave station, on the Southern Pacific Railroad. These lodes are of good size, and appear to carry a large percentage of high grade ore, the test made of it indicating that it will mill \$25 per ton. A district named the Kramer was soon after organized, and work commenced on several of the ledges, some of which have been opened to a depth of sixty or seventy feet with steadily improving prospects. These mines are only about four miles from the line of the Atlantic and Pacific Railroad. As there is neither wood nor water in or near the district, these ores can only be worked on the ground at great expense; unless, to be sure, they are rich enough to bear shipment elsewhere for reduction, as, by some parties who have examined them, they are said to be.

LASSEN COUNTY.

The mines of this county lie mostly on the easterly slopes of the Sierra Nevada, or in the detached ranges to the north, which may be considered a continuation of the main Sierra. The earliest mineral discoveries in this region were made in 1860, by prospectors from the Comstock mines. Owing, however, to Indian troubles, but little work was done on the first locations made here, these having afterwards been abandoned. At a later period the finding of some placer diggings drew into the county a small population, who, after working out these surface deposits, began the search after quartz lodes, a good many of which were found and taken up. Three mining districts have been organized in the county, the Hayden Hill in the northern, the Antelope in the southern, and the Lassen in the southwestern part. Some portions of these districts are dry, barren and treeless. They are, however, for the most part pretty well supplied with wood, water and grass.

While a good deal of exploiting labor has been expended on these mines, no large production of bullion has yet been made here, the severity of the winters and the remoteness of the mines having operated to their disadvantage. Some

of the ore is also difficult of treatment, and it will probably be some time before any considerable number of works for beneficiating these ores will be erected there. Meantime claim owners, confiding in the richness of the deposits, keep work going, many shafts, varying from 50 to 200 feet in depth having been sunk, and some lengthy tunnels driven on the veins, which carry in some instances only gold, silver or copper, while in others the ores contain a combination of all these metals.

LOS ANGELES COUNTY.

Although the first placers ever worked to any extent were located within the present limits of Los Angeles, its modern achievements in this line have hardly been sufficient to entitle it to be classed among the mining counties of the State. Nevertheless it contains both gold and silver bearing deposits, the former consisting mostly of the shallow placers found in the San Fernando Mountains, though there are some auriferous veins and hydraulic banks found also in that and other ranges of mountains in the northern part of the county. Efforts were made some years ago to work some portions of these latter deposits by the hydraulic process, but the attempt proved a failure, notwithstanding the equipments were very complete and the work was conducted in a skillful manner. The water supply was, to be sure, rather limited, but to the lack of gold in the gravel the failure was no doubt mainly due. But whether due to the lack of water or the lack of gold matters not, as neither of these elements of success, if absent, can very well be supplied here.

Within the past three years a company has been incorporated and is now constructing a ditch to bring water into the Palom̄s placers, in the northwestern part of the county, with a view to working them by both hydraulic and sluice washing. Should the effort result in a success at this point, it will probably lead to other operations of a similar kind being undertaken, as the auriferous gravel deposits in that vicinity are tolerably good and quite extensive.

While the argentiferous lodes in the so-called Silverado district in this county, about which there was a good deal of talk four or five years ago, amounted to little, quartz mining appears meantime to have undergone some revival in different sections of Los Angeles. A number of auriferous quartz lodes have been discovered and located in what is called the Piru district, thirty miles northeast of the town of Santa Paula; and although but little work has been done upon them, they are said to prospect fairly. There has always been more or less placer mining done in this district, and when water could be had, with paying results. The main drawback heretofore has been the impossibility of conveying the water of the Piru creek to points where the best paying dirt was found. The expense of transporting the dirt to the creek and washing it, in a majority of cases, exceeded the yield of the gravel.

On the Kelsey mine, in San Gabriel Cañon, twenty-five miles from the City of Los Angeles, a good deal of work has been done of late. This mine is situated on the mountain side at a considerable elevation above the bottom of the cañon, and the company has constructed a trail in order to have communication with it at any stage of water. The ledge has an average width of three feet, and the ore runs from \$20 to \$40 per ton. A tunnel has been run to the mine, and if the prospect continues as favorable as at present, the company will erect a mill for reduction of the ores.

An important discovery was made three years ago twenty-eight miles north of the City of Los Angeles. The ore here is strongly impregnated with petroleum, iron and free gold. This combination is so peculiar and unusual that probably the usual process of reduction will not apply, and some new method will have to be devised, as in an ordinary furnace the petroleum in the rock would likely destroy the iron before the ore could be reduced. It is possible, however, that a moderate roasting of the ore before placing it in the furnace would expel the petroleum. From the character of the country, and the vast deposits of petroleum that exists be-

neath the mineral rocks to the north of that city, it is evident that a large amount of the mineral-bearing rock in that location is impregnated with oil. In the northern part of the county is a vast amount of this ore, rich in gold, and it may be impregnated with petroleum.

A ledge of graphite, said to be of good quality, 40 feet wide, has been opened twenty-five miles from Los Angeles.

Upon the extensive gravel banks in the San Francisco and the San Francisquito cañons a steam dry-washer was introduced and set to work in the early part of the present year, Mr. G. W. Brown, of Los Angeles, has formed there a company for the purpose of operating these machines in the above localities. This gentleman reports the trials made with this washer a great success, the machine being able to handle a considerable amount of gravel, from which it separates the gold and saves it quite as effectually as can be done with water. Should continued use confirm these first results, the employment of these machines will be likely to greatly extend the working of this class of deposits wherever situated. This dry-washer has also been experimented with in what are known as the Alpine placers, in the same county, where it is said to have performed its work equally well.

MARIPOSA COUNTY.

As a general thing, gold mining has, from the first, been carried on in this county with more than an average degree of success, notwithstanding several notable failures have here occurred. The disasters attending the operations undertaken at an early day on the Fremont estate, due wholly to mismanagement, followed by costly and endless litigation, have proved very damaging to the reputation of Mariposa as a mining county, capitalists having been deterred, by reason of the magnitude of these disasters and the notoriety they attained abroad, from investing here to any great extent. While the mining interests of the county have suffered seriously from these untoward events, they have at

last about outgrown their effects, being at this time in a tolerably prosperous condition. For the past year or two much healthy progress has in fact been made here.

While such is the case, singular to observe, not a mine in this county situated on the great Mother Lode, the site of the Fremont fiasco, is now being, nor has any for some time past been worked. A Huntington mill has been running during the past year at Quartz Mountain and doing remarkably well. A new 10-stamp mill has been put up on the Mallet mine near Indian Gulch, and got to work. Another new mill of like capacity has been operating successfully on the Vanderbilt ores. A water-power 5-stamp mill has in like manner been dealing with the ores from the Malone mine. The new mill on the Hasloe mine is running and reported a success. The company having relieved the mine of water, have since proceeded with the work of sinking the projected main shaft, keeping now a considerable force of miners constantly employed. The Enterprise company are raising ore and operating their mill, which it is expected will have a long run.

Work continues to be actively prosecuted on the Cranberry mine, situated on the north side of the main Merced river at a point two miles north from the Hite mine. It has an elevation of about 2,700 feet above sea level and some 1,100 feet above the river. This has the reputation of being one of the most promising properties in Mariposa county. The lode here is strong, having an average thickness of 10 feet, and carries a large body of ore, much of which is extremely rich. A. H. Ward, manager and principal owner of the mine, intends to put up a mill upon it in a short time, having already spent a large sum of money in developing it. The country in which this lode occurs is granite with slate walls, the granite being superimposed upon the slate. Messrs. Ward & Craig have two water-power arrastras which they have kept in motion for some time past, grinding about one ton per day of rock, with an average yield of \$34.60 per ton. This rock was taken from the old shaft opened by Mr.

Craig. The new strike is by a crosscut about 500 feet southeast from the old shaft, and on the opposite side of a ridge giving a lift of over 100 feet on the vein.

Among other notable properties in this county is that belonging to Capt. John S. Diltz, commonly known as the Diltz mine, and upon which a large amount of exploratory labor has been performed, the work here, consisting of shafts, tunnels, drifts, etc., some of which are of great extent, disclosing heavy bodies of high grade ore. Good judges are of the opinion that large quantities of ore can be obtained here that will mill \$20 per ton. The gulches in the vicinity, which were worked as early as 1850, all proved exceedingly rich, having been fertilized by the gold from the Diltz quartz lode. Three and a half miles of iron pipe would bring upon or near to the mine enough water to drive 100 stamps. A good deal of ore has been taken from this mine and worked with profit, and the property now only awaits milling facilities to become a large and permanent bullion producer.

The Hite's Cove mine, on the Merced river, was sold several years since to an Eastern company. Up to the time of such sale, hardly any mine in California had a better record than this. Through the gross mismanagement of this company's agents, the property having reverted to Mr. Hite, the original owner, it is now being restored to working shape, which accomplished, it will no doubt soon come again into bonanza, and finally retrieve its fallen fortunes. Mr. Hite's confidence in the mine remains undiminished, notwithstanding it has so been placed temporarily under a cloud.

A projected improvement calculated to greatly promote the mining interests of this county is that about to be undertaken by Mr. M. Hulings, and which involves the building of a narrow gauge railroad from Hornitas to the Merced river, six miles distant. This road is designed for the transportation of ore, of which there are vast quantities about Hornitas, but the locality is now without natural facilities for its reduction. Large mills to supply this want are to be

built on the Merced, which stream will afford cheap and ample motive power for driving them the year round. The cost of milling will be so small that even the lowest grade ore about Hornitas can be made to pay. Though the enterprise will be attended with a heavy outlay, it is in a fair way to be put through, and there is little doubt but it will, when completed, prove an excellent investment.

The 10-stamp mill of Adams & Carter, on the Harbert and Rollins mines; the 8-stamp mill on the Ferguson mine; the 10-stamp mill on the Francis mine; the Gambetta, the Lafayette, the Compromise, the Wide West, the Maggie Johnson, and the Duncan 5-stamp mills have all been running with but little interruption of late, and earning for the owners at least living wages, and as a general thing a good deal more. In the Hornitas district, the ore from the London and Quartz Mountain mines have been worked with one of the Wiswell Electric Pulverizers and Amalgamators.

Besides the quartz mills above mentioned, there are several others running in this county and making fair earnings, but about which we have been unable to obtain more definite information. Several arrastras are also being successfully run here. A number of stamp mills are idle, some being old and worn out, and a few because of legal complications; hardly any of the mills in Mariposa being idle through lack of ore to keep them profitably employed.

MODOC COUNTY.

Only in a very limited sense can Modoc be called a mining county, her resources in this direction, so far as discovered, being mostly confined to two or three localities of no great area, and of which Hayden Hill appears to be the principal. The deposits here, which consist mainly of quartz, have been opened up by means of shafts and tunnels, and prospect well in free gold. Small quantities of ore taken from some of the narrow veins, which are much decomposed, have milled as high as \$100 per ton, and in

some instances more. Several of the many locations made have been somewhat developed, a few quite extensively, and considerable quantities of good ore taken out. Three quartz mills have been put up in the Hayden Hill district, and for several years past have been running pretty steadily and with a fair share of success. Several arrastras have also been run on the richer ores taken out. The remoteness of the district, which can be reached only by long and costly wagon transportation, has greatly retarded its progress.

During the past summer some good drift diggings are reported to have been struck at Empire Bar, on the Klamath River. So far as known, these, too, are of limited extent, though several claims are said to be paying extremely well, some of the gravel taken out yielding over one hundred dollars to the car-load.

MONO COUNTY.

Placer mines were worked in this county, at Monoville, as early as 1858. The discovery of quartz lodes near that place in 1860, led to the abandonment of these placer diggings a year or two later, by which time they had become pretty well worked out. Only at the present town of Bodie have the quartz deposits in this county been worked extensively or with any marked success. A great deal of money was expended in putting up mills and opening the quartz veins about Aurora, located 12 miles northeast from Bodie and just over the line in the State of Nevada, the heavy expenditures made at that place having resulted in an almost total loss. Some little work was done about the same time on the quartz veins in the Bodie district, near where the present town now stands, but with such discouraging results that the small crushing appliances put up there were removed and the district abandoned; and not for the next 15 years was anything further in the way of mining attempted in that locality. About the end of that time, prospecting having been renewed at Bodie, brought to light some very promis-

ing gold-bearing lodes, which, passing into the hands of energetic parties, were soon developed into paying mines. In 1877, a San Francisco company, having bought the Standard ground, proceeded to open it up and erected a mill and hoisting works upon it. In the month of September of that year, dividends commenced being paid by the company, and were continued for the next seven years when they ceased, and have not since been resumed, nor is it likely that they will be very soon, though some there are who hold a contrary opinion. For nearly two years past, the mine has made no net earnings, nor has it yielded enough bullion to defray current expenditures. Still the prospects here are by no means desperate, some promising ore developments having been made of late on the lower levels of the mine. The Company report for 1884 a production of \$304,294.76, considerably more than will be taken out the present year. The total bullion product of the Standard to date amounts to something over \$10,000,000, of which nearly one-half has been disbursed to the shareholders in dividends. The bullion here produced has contained about one part silver to seven of gold. During the year 1884 and the first nine months of 1885, the weekly ore extraction here averaged about 400 tons, besides large quantities of tailings worked over with some profit. The plant on this mine consists of a 50-stamp mill and first class hoisting works, both driven by steam. The company have employed for the past two years an average of 70 men altogether.

As has been the case with the Standard, so have all the other bullion producing mines at Bodie suffered of late a great falling off in their output of bullion, scarcely any dividends having been paid by them for the past two years. The following table shows the bullion shipments made from these several mines during the year 1884, and which, it may be remarked, are considerably in excess of what will be made the current year:

| | |
|---------------------------------------|----------------|
| Standard Consolidated..... | \$304,294 76 |
| Bodie Consolidated..... | 617,310 18 |
| Syndicate..... | 155,244 36 |
| New Standard..... | 17,714 76 |
| Bodie Tunnel..... | 2,075 90 |
| Wagner's tailings mill..... | 17,600 00 |
| Virginia Creek Hydraulic Company..... | 21,300 00 |
| Scattering..... | 8,630 00 |
| Bodie ore..... | 714 00 |
| Total..... | \$1,144,883 96 |

But with all this falling off in gross earnings, the work of exploration is kept up on these mines with a good deal of vigor, the town of Bodie continuing to be the center of greatest activity. Some two hundred men are employed in the mines and mills at that place, with about as many more engaged in mining pursuits elsewhere in the county.

In the outside districts throughout this county general dullness in mining matters has for some time past prevailed. Ore extraction, except at a few points, shows little or no increment, nor have prospecting operations been as active as usual. While most of the mills have been kept busy, a few have remained idle, not more than two or three new ones having been put up in this county for some time past.

A very complete and powerful plant has lately been placed on the gravel deposits situated to the west of Mono Lake. These deposits have long been known to be rich, but the difficulty of introducing water and securing outlet was supposed to present insuperable obstacles to their successful working. Mr. John F. Cassell, the well known mining man of San Francisco, having purchased the property, readily found ways and means for overcoming these difficulties, and having afterwards outfitted the claim in excellent style, has since been running it with altogether satisfactory results.

NAPA COUNTY.

The mines of this county, which consist of silver-bearing lodes, are confined mostly to a single district, located on the southeasterly slope of Mt. St. Helena near its base. They

are distant about three miles from the town of Calistoga, whence they are reached by a good wagon-road leading nearly up to the mines. These lodes were discovered some twelve or fifteen years ago, at which time a district was organized and over a hundred different claims located. Afterwards, and within the next two or three years, a good deal of exploratory work was done here; a mill was erected in the neighborhood, and a number of working tests, and even some considerable crushings were made of the ore, but with such discouraging results that work soon came to a standstill, and most of the claims were afterwards abandoned.

Recently, interest in this district has been somewhat revived, and if reports may be credited, large quantities of rich argentiferous ore are being taken out from some of the mines there; the greater portion of it coming, it would appear, from the claim of Messrs. Grigsby & Johnson, who are said to have accumulated a considerable amount of hundred dollar ore, awaiting the completion of the Selby Smelting Works to have it beneficiated. Upon several other mines in the district work has been resumed during the past summer, and is still in progress. From some of these mines ore is being extracted, and there is a talk of new mills going up there should the present showing of ore continue to improve for a while longer. As, however, the most of these ores are a little base, the mine-owners will probably find it to their advantage to have them treated at the Selby Works rather than undertake their reduction by mill process.

NEVADA COUNTY.

[Remarks on the mines of Nevada County, page 227, are here continued, the preceding articles on Lassen, Los Angeles, Mariposa, Modoc and Mono Counties, having through inadvertence in making up forms, been placed in their wrong order.]

The North Star, another of the ancient mines of this district, situated three-quarters of a mile southwest of New York Hill, has after a long period of neglect, been restored to good shape and brought back to a productive condition.

New and powerful steam hoisting works have been erected upon it, the old drain tunnel, 2,600 feet in length, has been cleaned out and retimbered, and sinking having been resumed, a good deal of ore is coming out of the mine, which seems now in a fair way of becoming once more an active and profitable producer of bullion.

The Crown Point mine, situated on Wolf Creek, in the southerly outskirts of Grass Valley, presents another case of the lame and halt being made to walk. For years this property had been idle or worked only in a feeble and spasmodic way, and with little or no benefit to the owners. Subsequently it came into the possession of Mr. A. A. Gauthier, an experienced miner and an indefatigable worker, who proceeded to develop the lode in good shape, putting down an incline shaft upon it to a depth of 200 feet, and drifting from it both ways on the lode. Later on, a 10-stamp mill and hoisting and pumping works were put up, all run by water, which being taken up after it leaves the Idaho mill, costs Mr. Gauthier nothing. This water is dropped on an overshot wheel 30 feet in diameter, generating ample propulsive power for driving all the machinery on the mine. The lode here, which occupies a fissure with walls smooth as glass, has a thickness on top of fully 3 feet, being very compact and somewhat larger in the lower workings. It carries a very tractable ore that yields \$18 per ton free gold, and 3 per cent. sulphurets, the latter being collected by passing the pulp over blankets, for which the Denniston Copper Silvered plates are about to be substituted. To such an extent has labor-saving machinery been introduced here that 15 men suffice for operating both the mill and the mine, which are run day and night the year through. Owing to the regularity and smoothness of the walls, the ore can be extracted from this mine readily, a single blast of giant powder breaking out often as much as 6 or 8 tons.

Mr. Gauthier's experience furnishes a good example of what can be accomplished by industry, persistence and economy. Without meeting with any special good luck, he

has by carefully saving his earnings for many years been able to buy, equip and pay for a very valuable property, of which he is now the principal owner. In still other respects he has set an example that ought to meet with a larger following. He has not only done his work well, but he has staid by it, having planted his home right over his mine; and where else in the world can be found a more pleasant place for a home than here in the vicinage of Grass Valley? What Mr. Gauthier has done any other man capable of performing severe physical labor might in like manner accomplish, the opportunities for doing so being abundant in the mines of California.

The Rocky Bar mine, situated on Massachusetts Hill, is one of the oldest locations in the Grass Valley district. The fortunes of this mine, like the occurrence of its ores, which lie in rich bunches, have been very uneven. A great deal of gold has, however, been taken from it, and this without by any means exhausting its stock of ore. The mine has not, in fact, been worked to a very great depth, and there remains yet much virgin ground above the lower levels. The workings here have a vertical depth of only about 200 feet—400 on the incline, the lode standing at an angle of about 40°. There is need of more capital to open the mine in depth, and work it as its merits deserve; many of the owners, mostly residents of Grass Valley, being men of small means, and unable to contribute sufficient money to that end. There are two veins on the surface here, and which, as they pitch towards each other, it is expected will come together below, and forming one lode communicate to it their common fertility. The vein pitching south proved extremely rich, the ore taken from it in former times having yielded from \$50 to \$60 per ton. The ore now being extracted yields about \$20 per ton free gold, with 4 per cent of sulphurets. There is a 10-stamp steam mill now running, and new hoisting and pumping works on the mine—everything about it being in good order. The Denniston plates are used for catching the free gold. It costs about \$10 per ton to

mine and mill the ore here. With needed improvements effected, the cost of ore extraction would be greatly reduced. About thirty men are employed in the mine and mill—all whites. There are, in fact, very few Chinese employed in the quartz mines about Grass Valley, or, for that matter, anywhere else in Nevada County.

New York Hill, another of the old-time mines of Grass Valley, adjoins the Rocky Bar ground on the southeast. While this mine has in times past turned out a good deal of gold, it has, like its neighbor, experienced many vicissitudes, and principally for the same reason—the lode being very uneven, expanding sometimes to a width of several feet and again contracting to only a few inches, the ore also occurring in bunches. The walls, a compact slate, have also proved very hard, rendering ore extraction difficult and costly. The lode, which pitches at an angle of 33° , has been opened up by an incline carried down on it over 1,400 feet, sinking being still in progress. This mine has first-class hoisting and pumping works, but no mill upon it. Indications point to the early discovery of millable ore in the lower workings of the mine. Some good quartz has from time to time been taken out by the tributers working here from the tenth level south, and also from the eleventh level north; and there is a prospect that these finds will develop into permanent ore bodies. A winze sunk below the 1300-foot level has opened up into quartz carrying gold but no sulphurets, which is construed into a favorable sign by Captain Johnston, a veteran on the Hill, now in charge of the mine. Twenty-four men are employed here, with probabilities of the labor force being shortly increased.

MINES IN THE GRASS VALLEY DISTRICT.

The North Star has been in its day both a prolific and profitable bullion producer, having turned out a total of \$3,000,000. Some three years ago, and at a time when the mine was still affording much good ore, work suddenly ceased upon it, the buildings were taken down, and together

with the machinery sold, after which the lower works filled with water up to the drain-tunnel level. It remained in this condition until the spring of 1884, when Mr. Wm. B. Bourn, getting control of the property, incorporated a new company, with 100,000 shares of stock, which were readily taken in San Francisco, where Mr. Bourn's financial and business abilities were well known and highly appreciated. Forty thousand dollars of these shares were sold, and with the proceeds steam hoisting and pumping machinery was purchased and placed on the mine; after which the incline was cleared out, enlarged and repaired, and the lower levels, having been relieved of water, tributaries were set to work and much good ore brought to the surface; a force of miners having been introduced later on, and put to getting out ore on company account. Since that time the old stopes have not only been worked with profit, but new ground, of which there is here a great deal, has been invaded with the most encouraging results. The company having not yet erected a mill of their own, have hired the 10-stamp Larrier mill on Wolf Creek for reducing their ores. This mine employs about sixty men, and is under the superintendence of Mr. David McKay.

In so resuscitating the North Star, the younger Mr. Bourn has been but repeating the lesson his father, the late Wm. B. Bourn, had taught him. The Empire mine, before it passed into the hands of its present owners, had experienced a somewhat checkered career; its many reverses and mishaps having at last impaired its credit and brought its operations to a standstill. The ore stock was exhausted; the mill, of limited capacity, was out of repair, and the underground works in bad condition. In this low estate, Mr. Bourn, the elder, justly comprehending its not then very obvious merits, bought the property at a moderate figure; after which he proceeded with the work of its rehabilitation, which was well advanced during his lifetime. Later on, further improvements were added, bringing the entire plant

to its present state of perfection, and enrolling the mine among the best in the Grass Valley district.

The Magenta mine adjoins the Empire on the north, the two properties being under the same control. An incline shaft has been sunk on the lode to the 400-foot level and some very rich ore taken out, but how the great body of the ore will range has not yet been determined. The property, however, is supposed to be valuable. The hoisting and pumping works first put up proving insufficient to drain the lode, a tunnel 1,000 feet in length has been driven, intersecting the incline at the 200-foot level, and insuring drainage above that point. Mr. Bourn has since put up more powerful hoisting works with a view to pushing explorations to a greater depth. About 20 men are employed at this mine. There being no mill here, the ore taken out is worked at custom mills.

The Peabody mine, formerly known as the "Gambler's Ledge," is situated on Rhode Island Ravine, one-quarter of a mile south from the town of Grass Valley. It is what is known as a "specimen ledge," having for nearly 30 years been distinguished for the many rich pieces and small lots of gold-bearing quartz taken from it, a feature that still characterizes the mine to a wonderful extent. An incline shaft has been put down on this lode to a depth of 250 feet, and a drift extended from its bottom north 400 feet. All the way down the vein, which is from 6 to 12 inches thick, has shown in spots this marvelous fertility. Small select lots of the rock crushed in hand mortars have yielded at the rate of four or five hundred dollars per ton, the average ore taken out milling forty dollars. Many specimens, because of their beauty and phenomenal richness, have been sold for more than their intrinsic value in gold, having been bought by jewelers, collectors of mineral cabinets, curiosity hunters, etc.

There are hoisting works, run by water from the South Yuba Canal, but no mill on this mine which is being steadily worked. James Bennallack, superintendent on the

ground, is of the opinion that it will continue to yield this exceptionally rich ore indefinitely downward. The property belongs to an incorporated company—J. E. Brown, Phillip Richards and John Spaulding, the latter president of the company, and all residents of Grass Valley, being large owners.

The old Murchie mine continues to turn out bullion more than enough to pay current expenses, both of the company's mills, of 8 and 10 stamps respectively, being employed constantly on their own ores; some taken from their producing mine and some from lodes that they are prospecting. In drifting west from the bottom of their 700-foot shaft, a very valuable body of ore has lately been discovered. During the past eight years this mine has turned out a yearly average of \$100,000, free gold and sulphurets included. The ore taken out during this time has paid on an average \$13 per ton. The average cost of mining the ore has been \$6, and of milling \$1.65 per ton.

On the North Banner mine, work has been kept steadily going of late, the drifts from the end of the tunnel having been advanced both to the north and the south. Ore enough has, meantime, been extracted to keep the company's 5-stamp mill constantly running. There are two lodes here which it is expected will unite in depth and form a strong, rich vein. A lower tunnel is now nearly completed, which will open the mine far below its present workings. The ledge, before quite small, has recently so enlarged itself that the company are talking of adding five more stamps to their mill. The construction of a ditch and flume, introducing free water upon the property, has materially enhanced its value, it being now in excellent shape for future operations. Two Frue machines are in use here for concentrating the sulphurets, which are very valuable, commanding about \$200 per ton at the chlorination works. There has been taken out of this mine about half a million dollars, much of the ore formerly worked having yielded at the rate of \$75 per ton; at present it yields about \$12 per ton.

On Osborne Hill, two and a half miles southeast of Grass Valley, are situated two of the old historic mines of this district, the Phenix and the Green Mountain, both of which have been famous bullion producers in the past, nor are their resources by any means exhausted. They are, in fact, turning out still considerable quantities of more than average grade ore, which is worked at the custom mills at an average cost of \$2.25 per ton. Though at present without mills, these mines have been equipped with first-class hoisting and pumping works, and are both exploited very thoroughly. Their ownership rests in the citizens of Grass Valley, who still regard them as valuable properties, many being of the opinion that, worked with system and care, they will yet recover something of their ancient importance.

In the Phenix mine there is an eighteen inch ledge that mills from \$20 to \$70 per ton, the whole of the ore on the 200-foot level yielding under the stamps not less than \$30 per ton. A crushing of thirteen tons of ore from the Green Mountain, made in July last, yielded at the rate of \$125 per ton, the ordinary ore from that mine turning out about \$35 per ton.

On Boston Ravine, half a mile below the town, Mr. Patrick Rogers has put up a 10-stamp mill, which has been equipped with special reference to close working; and so well is this end accomplished, that the proprietor and his sons find little respite from their duties, the mill being run without cessation. As yet, Mr. Rogers has used steam as a motor, but expects soon to employ water for this purpose, whereby a saving of several hundred dollars per month will be effected.

The Slate Ledge, an old quartz mine on Wolf Creek, four miles south of Grass Valley, yielded well in years gone by, but subsequently remained idle until two years ago, when a new incline shaft was commenced, and is now down 250 feet. Drifts have been run southerly from the several levels, in all about 300 feet. The rock from a two-foot ledge averages \$30 per ton. New steam hoisting and pumping works

have been put up, and a Perrin's 10-stamp quartz mill does the crushing. Twenty-one men are engaged in and about the mine. Its prospects for the future are good.

The Imperial quartz mine, on Deer Creek, has an incline shaft of 280 feet, with drifts east and west 350 feet. The ledge varies from three to eight feet in thickness, and carries an ore of good grade, abounding with galena sulphurets. Steam hoisting and pumping works, and a 10-stamp water-driven mill have been put up on the mine, which gives employment to eight or ten men. Both the ores and the geological formation here strongly resemble those at the Idaho mine.

The claim of the Brunswick Mining Company, formerly known as the East Eureka, commences about one thousand feet from the east end of the Idaho ground, and runs thence north nearly three thousand feet, their ledge being considered a continuation of the Idaho ledge north, its general features, including course and dip, being the same. The claim of this company, which is covered by United States patent, includes within its boundaries the croppings of several other clearly defined lodes, all of which prospect well in gold. A drain tunnel four hundred feet long taps the main lode at a depth of one hundred feet. From the bottom of the engine shaft, 186 feet deep, a drift has been carried west towards the Idaho ground four hundred feet on the lode, which is well defined and carries gold all the way, the ore growing richer as the drift approaches the Idaho. The plant here consists of hoisting and pumping works and a 20-stamp mill, all first-class, and at present run by steam, though it is in contemplation to run the mill by water, which can at this point be easily procured through the system of works already projected by the Idaho company. The Brunswick company intend to put down a new shaft further west, where a pay chute of ore has been developed. With these projected improvements carried out, ore can be mined and milled here at very small cost. The ore already taken from this mine has paid well, and in its present hands the property has undoubtedly a very prosperous future before it.

The Pittsburg mine, one of the old and standard properties of the Grass Valley district, is situated about two miles in an easterly direction from the Idaho mine. Its record, up till the time ore extraction was suspended for the purpose of driving a new drain tunnel, was in all respects, a good one. This tunnel having been completed, it may be expected that the work of getting out ore will shortly be resumed, as the mine is equipped with an excellent plant, and the ore reserves are large, estimated by Hague and Heusch, two of our ablest mining experts, to contain something like ten or twelve thousand tons of ore that will net a profit of ten dollars per ton, the unexplored ground here being also very large. This new tunnel, in driving which nearly three years have been spent, has a length of 800 feet, and drains the mine to a depth of 200 feet, below which it makes but very little water, though the flow above that level is excessive. It was to catch this water and prevent its descending to the bottom of the mine to be thence pumped to the surface, that this outlet was provided. It has cost a large sum of money, the rock to be penetrated being very hard, but that it will pay for itself many times over in the end, admits of no question, as the mine is destined to have a long life and there will hereafter be little or no pumping required. The mine has been opened by shaft to a depth of 800 feet. The claim of this company, which comprises a linear extent of 3,200 feet, is covered by a U. S. patent. It strikes northeast and southwest, pitches southeasterly, and has an average thickness of about two feet, all of which consists of pay ore. The mill carries ten stamps, and is well equipped in all its departments. In view of the work to be done it will probably be found expedient to increase, perhaps double the crushing capacity of the present 10-stamp mill. Beyond this no extraordinary expenditure will be called for in the future, the mine being outfitted with an otherwise very complete plant and supplied with everything necessary to an economical and efficient administration of its affairs.

NEVADA CITY AND VICINITY.

The leading mine in this locality is the Providence, situated on Deer Creek one and a half miles below the town. We can recall no other instance in which so much good judgment and patient forethought has been displayed as in the conduct of this mine. It has been too much the case in California and everywhere on this Coast, that mine owners have rushed their ores through the mill, satisfied to get what free gold they might carry, allowing the almost equally valuable sulphurets to escape with the tailings, or they have engineered their properties with a view to a stock deal, or doctored them for a market. With the proprietors of the Providence mine, a very different policy has obtained. The property has, to be sure, been worked for all it was worth, but it has been worked at the same time in an honest, intelligent and economical way. Upon this claim, an early location, a vast amount of work was done year after year in sinking shafts and running drifts on the various levels without attempts being made to extract and reduce the ores to any great extent. The ore containing a large per cent. of sulphurets, the owners determined to do but little with them until a successful method of treating them had been devised. Thus the mine had been opened to a depth of 1,000 feet, and 14,000 feet of drifts run, and no ore extracted, except from the three or four upper levels. Within the last four or five years, however, by the use of concentrators, the sulphurets have been saved, a successful method of beneficiating them having meantime been hit upon. For collecting and saving this material, sixteen Frue concentrators are here in use, its reduction being effected by a process in some respects new, and which consists in part in dropping it from an upper or drying floor to a second, and thence to a third floor, the material in its downward passage being exposed to a continuous flame. By the process here adopted, the basest sulphurets are made to surrender all the gold they contain, save a very small percentage.

The main shaft in this mine has reached a depth of 1,200 feet, there being 16,000 feet of drifts run on the several levels. All the under-ground workings here have been planned and prosecuted throughout with a skill and system that borders on science. The ledge varies in thickness from 6 feet to 40, and even 50 in places. The hoisting works and the 40-stamp mill are run by water power, and the labor-saving appliances are so complete in both mine and mill, that the ore is mined, delivered to the mill, and milled for \$1 per ton. It is doubtful if there is another mine in the State of this magnitude where the entire work is done so cheaply as here. Since the 40-stamp mill was completed, over three years ago, crushing has been going on night and day, holidays and Sundays, not one of the stamps having been hung up for any long time. About 65 tons of ore are milled every 24 hours, and a surplus of about 800 tons is always kept in the ore-bin. It is estimated by competent judges that sufficient ore is uncovered in the mine to keep the mill constantly running for ten years without further drifting.

This company keep constantly 120 men in their service, all white, the most of the miners being Cornishmen. The most of these men have families, and occupy comfortable cottages, in close proximity to the mine. The wages paid here are as follows: underground workmen \$3 per day; carmen and general laborers, \$2.50; shovelers, \$2 to \$2.50. This company has never had the slightest trouble with their employees, as regards hours, wages or any other matter.

The Wyoming mine, on Deer Creek, a little below the Providence, is an early location, and like its neighbor, has had the benefit of a wise and economical management. It has been a steady going gold producer for a long time, having of late years been under the management of Mr. J. M. Buffington, Jr., a young man who has displayed special aptitudes for the position, and who, it may be remarked, *en passant*, in leaving the city and taking upon him the rough duties of a miner's life, has set an example that thousands

of our youth might follow with credit and advantage to themselves.

The Wyoming mine has been opened by an incline shaft 800 feet deep. From the several levels connecting with this shaft, drifting has been carried on extensively. In the lower levels, the ledge has an average thickness of 8 feet, the most of which is pay ore, carrying about 3 per cent. sulphurets. The plant here consists of a 15-stamp mill provided with the most approved modern appliances for saving time, labor and gold, including 8 Frue concentrators. The concentrates are not treated on the premises, the Maltman metallurgical works, near Nevada City, offering a good market for them. Both the mill and hoisting works are propelled by water, supplied by the South Yuba Canal Company at a cost of \$6 per day. The mill, which disposes of about 800 tons of ore monthly, is run with but little intermission, being an institution that knows neither holidays nor Sundays. The labor force employed here consists of 56 men, all told; nationality, wages and general conditions much the same as at the Providence mine.

The Nevada City mine, located on the ridge a little to the northeast of the Wyoming, is opened by a shaft 750 feet deep. The placing of new and more powerful machinery on the mine having interrupted ore extraction for a time, the 20-stamp mill of the company is again running on a good class of ore, of which the stock in sight is large. The ore here takes a wide range, running all the way from \$5 to \$50 per ton, occasionally some exceedingly rich specimens being broken out in the stopes. The property is a valuable one.

The Merrifield mine, another old location close to the Providence, works about fifty men, has a shaft down 1,000 feet, with a ledge three and a half feet wide at the bottom. The ore has been running rather low in gold of late, but present indications point to an improvement. The mine is outfitted with a 30-stamp mill and twelve Frue machines for concentrating the sulphurets; mill propelled by water obtained from the Rough and Ready ditch of the Excelsior company.

The Mountaineer mine, another near neighbor of the Providence, is a steady-going bullion-producing dividend-paying concern; owners all residents of San Jose; J. A. Hornburger, President of the company; John Snyder, manager on the ground. The lode, though not large, yields an abundance of fine gold-bearing quartz heavily charged with sulphurets. The mine is worked by tunnel, the 20-stamp mill and the hoisting and pumping machinery being driven by water power. Six Frue machines do all the concentrating here. Fifty men suffice for all the work required to be done, their duties being lightened by the labor-saving machinery introduced here. The management of the Mountaineer is good, and its prospects excellent.

ON THE SAN JUAN DIVIDE.

The paying quartz mines of this county are not confined to the neighborhood of Grass Valley and Nevada City, there being several outside of these localities that are making very satisfactory earnings. The Delhi mine, located three miles northeast of Columbia Hill, is showing itself to be a very valuable property; the 8-stamp mill, commenced reducing its ores about the middle of April last, since which time the company have paid the cost of mine, mill, and all improvements made out of the net earnings of this mill, and disbursed to the shareholders over \$20,000 besides. The ore, of which eighteen tons are put through the mill every twenty-four hours, yields over \$30 in free gold to the ton, besides a large percentage of rich sulphurets. The ore body, all of this grade, has an average thickness of nine feet. The daily expenses of running both the mill and the mine do not exceed \$50 all told. This mine is owned principally by Robert McMurray, an old resident on the Divide and a master miner; and by Judge Searls, of Nevada City. This property is attracting wide attention, and already the agents of San Francisco capitalists have been sent to inspect the mine with a view to securing it for their principals.

This rich find having led to further prospecting in the neighborhood, a number of other very promising ledges, some of them to all appearance the very counterparts of the Delhi, have been discovered and located. Among these recent discoveries is a series of three true ledges lying close together and running parallel with the Delhi lode, from which they are distant about half a mile to the west. These ledges are owned by John Spayth and S. N. Stranahan, veteran prospectors, and as good judges of quartz as any men living. They have refused the offer of a handsome sum for their locations, which it is said they do not care to part with at any price, preferring to convey an interest in them to parties who will put up a mill upon and develop them.

Lying in the vicinity of this Spayth find, and on either side of it, still other gold bearing quartz veins have been discovered, the most of these discoveries being of recent date, and every one of them seemingly of importance, because of their resemblance and proximity to the immensely valuable Delhi lode, which carries the characteristic ore of the neighborhood. Some of these recent discoveries have been named the Golden Gate, Delaware, Boss, Tip-Top, Golden Chariot, Dardanelles, Little Giant, and Golden Wonder; besides which, a series of lodes lying between the Spayth ground and the Delhi, previously located, and upon which a good deal of work had already been done, are beginning now to attract attention, being, to all appearance, the very counterparts of the bonanza lode running parallel with them only half a mile further to the east. These earlier locations, also triplets and lying near each other, are named the Black Oak, the Gipsy Queen, and the Siphthoroth, which latter the miners in the neighborhood, after their manner of abbreviating the vernacular, have shortened to the "Sip" claim. What imparts additional significance to this whole group of later discoveries is the further fact, that these veins, while they belong so obviously to the Delhi school, are in range with the Alaska lode, lying a mile further north, and not at all different from or less valuable than the Delhi itself. In

all their leading features, the whole of the veins mentioned are precisely alike. They have all the same northerly strike and easterly dip; they carry the same character of surface ores, and occur in the same geological formation. It is even the case that the croppings are as strongly marked, and these surface ores have assayed just as well in one vein as in another. In short, it looks very much as if a new and very important quartz field were going to be opened up here on the San Juan Divide; and it will not surprise those who know something about the merits of the district, if a great din of stamps is heard there before many months more have gone by. The country about possesses many natural resources and features tending to favor mining operations. It is of easy access and splendidly timbered, insuring always cheap supplies of lumber and fuel. The climate is one of the most healthful and pleasant in the world. Water can be had in large quantity and generally under great pressure for driving machinery, and the most of the ledges occurring on the sides of steep mountains, can be opened, worked and drained to great depths by means of tunnels. On some of them, it may be said that hoisting and pumping works will never be required.

WASHINGTON DISTRICT.

As these recently discovered mines are coming rapidly into notice, so are those in the Washington District, an old locality lying 18 miles further south, being steadily developed into large and profitable bullion producers, every few months for several years past having added one or more to the number. Some of these Washington mines were opened up and successfully worked more than thirty years ago. At the time of the Washoe excitement the district was deserted and very little was done there for the next ten or twelve years, after which the early locators returning, gradually resumed work on their claims, the most of which, under active prospecting, are developing into first-class properties.

Among the mines here that have been outfitted with mills and have already made themselves conspicuous as producers of bullion, are the following : In the Yuba mine, situated six miles above the town of Washington, a $5\frac{1}{2}$ foot lode, regular and compact, has been opened by shaft and tunnel to a depth of 600 feet. The property is owned, mostly, by George Hearst, J. B. Haggin, and George E. Webber, of San Francisco. The entire ledge, so far as sunk upon, consists of ore that will mill \$30 per ton. The 15-stamp mill first placed on the mine, has since been increased to 25, and there is talk of further enlargement, or an additional mill being called for. The mill, which is run by water-power, crushes daily two tons per stamp, the ore being easily pulverized. With a lode like this and the milling facilities here at hand, \$5 ore could be worked with profit. The property is under the supervision of George A. Hare, who has managed it with skill and care. The Yuba is an early location, having been the second one taken up in the district.

The Eagle Bird mine, owned by Shattuck & Co., mining men of San Francisco, and situated on the south side of the Yuba River, is opened by shaft to a depth of over three hundred feet. The ledge, having an average thickness of eight feet, is all put through the mill, and yields about \$20 per ton in free gold, with a considerable percentage of sulphurets worth \$360 per ton. Through the 20-stamp mill and the two Huntington crushers operated here, sixty tons of ore are passed daily. Mills, hoisting works, pumps and air-compressors are all run by water, of which the company owns an unlimited supply — several Pelton wheels being used. Twelve men suffice to do all the work required here.

The Cornucopia and the Secret Treasure lodes, situated near each other on the north side of the Yuba, belong to an English company. They are early locations, the Cornucopia being the first claim taken up in the district. This company erected last winter a new 10-stamp mill with hoisting and pumping machinery heavy enough to work the mine

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one thousand feet deep. The incline on the lode is being sunk night and day, and is now down several hundred feet, with a good-looking, fair-sized lead in the bottom. The company's mill, since being completed, has been running on ore that yields \$18 per ton, and of which they have large quantities in the mine. Five or six dollar ore would here afford some profit with the facilities at command for handling it. The company own four locations, containing lodes that vary from three to fifteen feet in thickness. All the machinery here is driven by water, obtained by catching up that from the Lindsay mill on the mountain above, and which can be used under a pressure of 340 feet, generating ample power to drive thirty stamps or more.

The Lindsay mine and new mill, owned by Messrs. Great-house, Bell and Robinson, of San Francisco, are located at a great elevation on the mountain above the English company's mill. This mine has been producing for several years and made large net earnings. The lode here is of good size, and occupies a strong, true fissure in the gneiss, the predominant rock of the country. Connected with the property is a first-class water-power, ample for driving one hundred stamps if required. This ore yields from \$15 to \$20 per ton in gold.

The Waters mine, a short distance above the Eagle Bird, is being opened in depth by a tunnel carried in from the south bank of the Yuba River. A large quantity of gold-bearing quartz has been taken from the mine, which is considered to be a valuable property. Crushing done with a Huntington mill.

On the Spanish mine, three miles north from the town of Washington, two Huntington mills have been running and doing such satisfactory work that the company intend to order two more of these machines. The claim here, which comprises 4500 linear feet, covers a rich but peculiar formation, consisting of quartz, chrome iron and slate, occurring in alternate streaks, the entire belt carrying gold, and being over 100 feet wide.

Up near the town of Omega, C. G. Ferguson having de-

veloped a very valuable mine, erected thereon the past summer a first-class mill, which, since its completion has been running with excellent results.

Over on the Gaston Ridge, beyond the South Yuba, several mills have been put up, some of them a number of years ago, and from all favorable reports come to hand. The small mill of the Thurston Brothers, has for some time past been making a profitable production. The 10-stamp mill on the new California mine, which had long been suffered to stand idle, is again at work, and said to be doing well. The Gaston Ridge mine, four miles from Eureka South, was worked from 1855 to 1862. During this period George Hearst, the since successful mining man, is said to have taken out quartz here on contract, at the rate of \$1.75 per ton, working in the mine part of the time as a common laborer. There is a 10-stamp mill on the property, which is still considered to be a valuable one, having turned out a great deal of bullion without at all impairing its capacity for production.

PLACER COUNTY.

Generally speaking this county has been more noted for its hydraulic and drift, than for its quartz mines, but few of the latter having ever been worked with much success. On the other hand, the hydraulic and drift deposits have generally paid well, as many of the latter are doing at the present time, and as several of the hydraulic claims were doing before they were closed by legal mandates.

THE QUARTZ MINES

Of Placer are confined mostly to the western part of the county, though there are some good looking lodes in the more central parts. In the Penryn, the Ophir and the Auburn districts, where formerly much quartz mining was being done, the business has for the past few years been on the decline, idle mines, mills closed down and abandoned

prospects being the order of the day. It may be said, however, that present signs point to an early improvement. On the quartz lodes in the vicinity of Humbug Canyon, about Damascus, and further east, not much work has been done of late, notwithstanding many of them show very encouraging prospects on the surface. On the Pioneer vein, lying one-half mile west of Damascus, Mr. Jacob Neff has done considerable work the past summer, and to such good purpose that he is reported to have refused a large sum for the property. The product of the quartz mines in this county, which amounted in 1883 to something over \$300,000, will not the present year reach half that sum.

HYDRAULIC MINING IN THIS COUNTY

May be said to be in a state of suspended animation, with some hope that it may, through legislative action, be restored to life. The mischief wrought by the closing down of these mines by injunction is incalculable—the misery appalling. Flourishing towns have in consequence been depopulated. Men, well-to-do only a few years ago, have been financially ruined, and even whole communities brought to the verge of bankruptcy. Hundreds of industrious and well-paid men have been converted into tramps—forced to leave their homes and seek employment elsewhere, it being impossible for them now to get work in the mines. Families have been broken up and scattered, the fathers being no longer able to keep them together. Other industries throughout the enjoined districts, suffering through the destruction of this their main stay, have languished and died; and so desolation broods over the homes, and silence reigns throughout a country once enlivened by the roar of a mighty industry. Not only so, but the two great leading interests of the State have been arrayed against each other in deadly hostility, the public mind having been poisoned by partisan malice and misled by persistent misrepresentation. That the people of California, when they come to comprehend the situation, will longer tolerate this state of things would

be to suppose them capable of the grossest injustice. It may therefore be presumed that they will, through their legislative representatives, hasten to redress this great wrong. Being so paralyzed, there remains of course, nothing more to be said concerning a branch of mining that only four years ago turned out in this county nearly as much gold as all others put together.

DRIFT OPERATIONS.

Turning to this branch of mining we find it to be very actively pursued at the present time along all the "Dead River" channels, of which there are a great many in Placer; some noted for their extent and fertility. The claim of the Golden Gate Drift Company, located at Damascus, was formed many years ago by a union of the Golden Gate and Mountain Gate grounds, and includes now an area of 1004 acres, covering a portion of the two main "Dead River" channels that traverse this section of the county, and known respectively as the white and the blue. This ground was located in 1852, and operations commenced upon it soon afterwards have been kept up steadily ever since. The property is owned and the work carried on by an association of miners, all of whom own one or more shares of the stock, and the majority of whom work daily in the mine, members furnishing a substitute when for any reason they are absent. The plan of working miners uniting and operating after this manner has been found to succeed better than any other, nearly every notable success in drift mining having been achieved by organizations of this kind.

The Golden Gate Company, as at present constituted, is composed of the following parties, the most of them representing themselves on the ground: Nicholas Weaver, foreman; G. W. Snyder, John T. Ashly, Solon Sleeter, Wm. Rowland, Charles Boardman, Lewis Williams, John Parker, John Thomas, George Taylor, William Browne, R. J. Thomas, Daniel Abraham, Owen Jones, A. B. Campbell,

Mrs. J. N. Lombard, R. H. Jones, J. P. Raines, and Christopher Elliott. About 20,000 linear feet of tunnels and drifts have been excavated in this mine, the lower and present working tunnel being over 7,000 feet long. Three tunnels have been driven here, the one below the other, necessitated by the different levels on which the two channels occur and by the pitch of the bed rock carrying the pay gravel below the tunnel level, the existing condition of the mine. To raise the water and gravel up to the present working tunnel, two 36-foot over-shot wheels have been erected on the line of this tunnel, these wheels being propelled by water coming in from the upper channel. Far within their dark chambers these enormous wheels revolve without rest or pause the year round. Cessation of their labors for a day would flood the lower drifts and produce irreparable mischief. The loaded cars, after being brought to the head of the incline by water power, are taken out through the tunnel with horses, and when emptied, in like manner returned. These tunnels are 6 feet high by $7\frac{1}{2}$ wide. The gravel in the channel is drifted out to a height of 6 feet and to an average width of 150 feet, this being about as much as will pay for removal. About 80 car loads, containing $1\frac{1}{2}$ tons of gravel each, are brought out daily. This gravel is washed in sluices and pays at the average rate of about \$1.75 per ton, the deposits here being extensive, but only moderately rich. The gold dust taken out is very fine but of fair quality, selling for \$18.60 per ounce. About 40 men in all are employed in this mine; \$2.50 per day being paid those working on hire.

What is known as the Bob Lewis claim, lying to the east of the Mountain Gate, and on another channel, is owned by Robert Lewis and Owen Griffith, who have worked it steadily for many years past. The gravel here is rich, paying from \$6 to \$8 per car load. The owners of the ground, with the aid of two or three hired men, have taken out from \$8,000 to \$10,000 every year. A larger working force might be employed but for a scarcity of water to wash the gravel.

There remains here a great extent of this rich channel to be worked. The gravel is brought out through a tunnel 1,200 feet in length, and washed in the usual way.

The Dam claim in the same neighborhood, is owned by six shareholders who have worked it steadily and profitably for 20 years, the gravel paying at the rate of about \$4 per car load. The yearly out put here averages about \$12,000. The claim includes 320 acres, covering a branch of the blue channel. The Hayden Hill, Whiskey Hill, and Mountain Gate, small claims, in the same vicinity, yield each from five to seven thousand dollars a year; the working force employed averaging about five hands to the claim.

At Sunny South, four miles westerly from the Golden Gate and on the opposite side of the ridge, is located the ground of the Hidden Treasure Company, covering about 9,000 linear feet of the white channel, with a section of the blue running through it. This is a well-managed and very valuable piece of property, being in excellent shape for efficient operations, and having been worked steadily for the past ten years, with a net profit of 40 per cent. on the total product made. This gravel yields from \$1.50 to \$2.50 per carload of one ton—from 250 to 300 car loads being extracted daily. This company employs from 60 to 80 men, divided into two shifts of 12 hours each, whereby work is kept constantly going day and night, and without cessation the year round. They commenced work on the ground, in September, 1876; ran first the lower tunnel, which has, drifts included, a length of 3,000 feet. Pay dirt was struck here when in 490 feet. This was used as the main working adit until about three years ago when the upper tunnel was driven, gravel extraction going on through the upper tunnel meantime. The channel in this ground varies from 200 to 600 feet in width and averages about 300 feet, the most of which is removed to a height of six feet above the bed rock. Specific gravity brings the cars out on an iron tramway, horses being used to take the trains back. The water from the tunnel is reservoired and used for wash-

ing the gravel which is piped into sluices. Quicksilver alone is employed for catching the gold, which is of the same character as at the Golden Gate mine.

The Hidden Treasure, like the Golden Gate property, is owned and worked by an association of practical miners, the names of the original company being as follows: Wm. Cameron, Alexander Cameron, M. H. Powers, H. K. Dev-eley, Reuben Sparks, L. P. Bernham, A. F. Boardman, Wm. Christy, Thomas Reese, C. Guilford, Lewis Rider, and A. G. Fuller. William Cameron and his brother, Alexander, own 17 of the 36 shares, into which the stock is divided—the former being superintendent of the mine. The property has never been assessed, the members themselves performing all the labor required to develop it to a paying point. It is greatly to the credit of the company that they have worked in harmony from the first, there having occurred here very little of that bickering and jealousy, apt to be so rife in organizations of this kind, defeating often what might otherwise have proved a prosperous enterprise. This harmonious coöperation has been due here, largely, to the fact that the members of the company being acquainted from the start, each was known to the other to possess the proper qualifications to make a good partner. The net earnings already made by this property having brought to these parties a competence, what may still be safely counted upon is bound to insure them an independence; not one-half of the rich channel traversing their ground being yet worked out.

There are a number of other drift claims in this neighborhood and within a few miles of Damascus, that are being developed or that have already been brought to a paying condition, the most of them being opened by means of tunnels carried in from the slopes of the adjacent deep cañons.

The Golden Fleece Company, at Deadwood, after driving a three thousand foot tunnel at an expense of \$40,000, are reported to have struck pay gravel, which they are preparing to take out on a large scale. A nine hundred foot tunnel

has brought the Georgetown Company also into good gravel. The Derby, Adams, Fork's House, Cape Horn, Alameda, Bear Hunter, Indian Springs, New Basil, Union, Spartan, Whisky Hill, and the Macedon claims, are all being prospected or have reached good gravel, some of which is being taken out and washed. The Weske mine, at Turkey Hill, for several years one of the largest drift producers in the State, having suspended operations a few years since owing to legal, financial and natural difficulties, remains closed, with but little prospect of an early resumption of work upon it. In the Last Chance District some revival of drift operations has been experienced during the past year, and as there is a large extent of gravel channels traversing that part of the divide which have not yet been worked out nor even thoroughly prospected, this locality offers a good field for further exploration. A great deal of gold was in former days taken from the old river beds at Last Chance, and it is the opinion of those most competent to judge, that a great deal more remains in these subterranean channels than has ever been taken out of them.

Hydraulic washing on the Breece & Wheeler claim at Bath having been forbidden by the Courts, the ground is now being worked by the drift method. Messrs. Breece & Wheeler, while they suffer severely by these rulings of the judiciary, are too good citizens to either oppose or seek to evade them, however seemingly unjust and arbitrary. For a time the drift operations undertaken here proved little remunerative. Persevering, however, the owners of the mine seem likely now to meet with better reward. Late in the present summer a body of gravel was struck which it is thought will pay at the rate of \$10 or \$12 per car-load. As the channel, however, is at this point narrow, the value of this find remains to be determined. Meantime, the owners of the mine have made preparations for working it actively. The 10-stamp mill at the mouth of the tunnel having been kept in good order, commenced on the first of October crushing this material, which proves so

hard that it has to be pulverized with stamps and otherwise treated after the manner of quartz rock in order to extract the gold from it. Fifteen men are now employed in and about this mine, it being the intention of the proprietors to increase the number should occasion require. Large wages—\$3 to \$4 per day—are paid here, Messrs. Breece & Wheeler, both practical miners, long in the field, appreciating the value of good service and being willing to pay a good price for it. There is a general hope in the district that the strike made in this mine will prove extensive and lasting, the stopping of hydraulic operations having thrown many men out of employment and created much distress among all classes, traders and employers as well as consumers and workmen.

Passing down the Forest Hill Divide all the way from Last Chance to Todd's Valley, a distance of nearly twenty miles, we find hydraulic mining everywhere dead, causing scarcity of money and a general depression of business. On some of the hydraulic ground drifting has been tried, but in most instances with such discouraging results that the business has been given up.

The Mayflower drift mine, situated about two miles northwesterly from the town of Bath, has, since the month of May last, been making a large production of gold. The location of the channel at that point having been first determined, a vertical shaft started in the old hydraulic pit previously washed out there, was carried down to the gravel, a depth of 200 feet. From the bottom of this shaft a drift was run easterly, following at first the pitch of the rim, but finally leaving it and running through the gravel and lava to the east side of the channel, the shaft having been put down on the west rim rock. From the end of this drift, another shaft was sunk to the bed rock, overlying which a stratum of rich gravel was encountered. This accomplished, a 20-stamp mill was erected at the mouth of the shaft, the gravel here being so held together by an indurated cement, that it has to be crushed, as at the Breece

and Wheeler claim. Both the mill and the hoisting works, with pumping gear, are run by steam, the water and gravel requiring to be lifted a vertical distance of 330 feet. Although the channel at this point is extremely wide—about 4,000 feet—only the richest portion of it, included in a strip about 90 feet wide, and from five to six feet in height, is drifted out. More might, no doubt, be removed with profit, but there is standing over this rich stratum a mass of auriferous gravel 60 feet high, which the company are in hopes they will be able some day to work by the cheaper hydraulic process, therefore they are not so particular now about working the deposit closely. This gravel, of which about 60 tons are extracted and milled daily, pays from \$15 to \$50 per ton, averaging at least \$25.

The mill and mine give employment to about 100 men, besides an army of woodchoppers and teamsters engaged in furnishing the works with fuel, of which a great deal is consumed. For the coming winter it is calculated that as much as 3,000 cords of wood will be needed, and strenuous efforts are being made to get the most of this in before the wet weather comes on.

The expense of operating the mine by the present plan of hoisting and pumping being great, a tunnel has been projected for working and draining it, whereby much of this expense will be obviated. This tunnel, which is to be carried in from the west side of the ridge, will be about a mile long. Though it will prove a somewhat costly work, its construction will effect great economy in the end, as drift operations will probably be in progress here for a very long time, the company owning several thousand feet on this channel. Moreover, the adit might be used by other companies owning claims on the channel both above and below the Mayflower ground after the latter is worked out, and, very likely, before that occurs. Then, too, there is a chance that this tunnel would intersect other channels or branch channels lying in its path, the system of "Dead rivers" on this Divide being exceedingly complicated, and their courses

so tortuous that they seem to duplicate themselves at some points. The Divide is, in fact, traversed by several of these channels, running in some places parallel, or nearly so, while in others they appear to interlace and form a network. Not only so, but they actually run on different levels, a feature that has defeated many of the efforts made to open them up by means of tunnels.

The new adit projected by the company will be of large size—8 by 9 feet. The work upon it will be commenced early in the coming winter, and will be prosecuted with power drills, the calculation being that it will require two years for its completion.

This property, which is an extremely valuable one, belongs to an incorporated company, the most of the shares being owned in San Francisco. The engineering work here appears to have been skillfully planned and well carried out, reflecting a good deal of credit on the engineer, Mr. F. Chappellet, now in charge of both the mill and the mine.

In projecting the difficult and costly work of exploiting this ground, Mr. Chappellet's views were strongly opposed by consulting engineers who stood high in the profession, but results have more than vindicated the soundness of the views expressed at the start, and since so ably carried out by him.

Lodged in several of the deep gulches on the Forrest Hill Divide are great quantities of tailings run off from the mines above. The heaviest deposits of this kind are found in Indian and Shirt-tail Canyons. As these tailings are known to be exceedingly rich in gold, there have long been entertained by the miners in the neighborhood a purpose of working them over, as would have been done long ago, but for the cost of removing the rocky barriers at the lower ends of these canyons, by which alone can this material be moved and run out. The success that promises to crown the effort being made to work over the contents of Indian Canyon has encouraged a similar undertaking on Shirt-tail lying a little further to the south. As the parties who have this

project in hand are not only financially strong, but have the right sort of experience to make it a success, a favorable issue for the enterprise seems assured.

PLUMAS COUNTY.

As a general thing, mining operations in this county have for a year or two past been a little disappointing. In quartz mining there seems to have been a difficulty in keeping more than a few of the mills steadily running, only the Plumas Eureka, the Green Mountain, and two or three others having reached any very large or encouraging results. All told, perhaps a half dozen mills have kept their stamps dropping without interruption, about as many more having run by spells, while a still larger number have been wholly idle. Among the mills that have been pretty steadily employed of late may be mentioned the Arcadian, ten stamps, doing work some of the time for the owners and some of the time for others; the Genessee, ten stamps, a tolerably regular but not large producer; a Huntington crusher, on the mines of Hopgood & Black, in the Mowhawk district; the Green Mountain, sixty stamps, running on company's ores; the Genessee, ten stamps, the Lucky, five stamps, and the Plumas Eureka, sixty stamps, running on ore from the company's mine.

The few arrastras in use here are run steadily, but the ores of Plumas are generally of too low grade to warrant much work being done by these machines. While there has been so comparatively little ore crushed in this county of late, a good deal of exploratory work has been done, many of the shafts and tunnels, before commenced, having been materially advanced, and some new work begun. Numerous small lots of ore have also been extracted and worked, or kept for future reduction. The short water supply the past summer, experienced here in common with the rest of the State, has had the effect to close some of the mills that otherwise would have kept running.

In the Green Mountain, the most extensively developed mine in the county, the Plumas Eureka excepted, a vast amount of exploratory work has been done. Tunnel No. 5, completed two years ago, gives three hundred feet of backs above it, which will furnish an immense amount of ore. Though the ore in this mine is not high grade, there is so much of it, and it can be handled at so little cost, that the property, owned by a New York company, is considered valuable.

The most important mine in this county, both as regards intrinsic value and production made, is the Plumas Eureka, belonging to an English company, and under the general supervision of William Johns, with J. Hoskins foreman at the mine. As one of the most notable quartz mines, not only of Plumas County but of the State, we give here a few leading facts connected with this property:

The Plumas Eureka mine, comprising what are known as the Seventy-Six and the Rough and Ready gold-bearing quartz lodes, is situated on the easterly slope of Eureka Peak, an isolated elevation in the Sierra Nevada mountains, the mine being 7,000 feet above sea level. These are strong veins, having a south-southwesterly strike with a westerly dip; the footwall a syenitic greenstone, and the hanging wall a talcose slate. A great deal of work has been done on these lodes, and their character is well exposed. A 60-stamp mill is constantly operated, crushing on an average 120 tons of rock per day, the mines employing 250 men, mostly Cornishmen. The running expenses average not less than \$25,000 per month, and two communities, Johnsville and Eureka Mills, containing at least one thousand inhabitants, are supported entirely by the mine. The mill is situated on the side of a hill, about two thousand feet below the mouth of the upper tunnel, from which the quartz is taken. This quartz is placed in a car and run down the mountain on a track at an angle of about 35°. A year or two ago there was some waning in the prospects of the mine, but from this it has more than recovered, the outlook being better at this time than ever before.

There is a good deal of placer mining still carried on in this county, mostly drift, now that hydraulic washing has been declared contraband. The sites of these drift operations are along the North Fork of Feather river and its branches, where, also, some river bed mining is practiced. The Chinese work over the old diggings, and generally manage, by their patient and pains-taking methods, to make good wages.

SACRAMENTO COUNTY.

Never has much mining been carried in Sacramento, except at two localities: Folsom, on the American Fork, and Michigan Bar, on the Cosumnes river; the operations at the former consisting mainly of drift, and at the latter, wholly of hydraulic mining. Nearly all the mining at Folsom is done by the Chinese, who take out in the course of the year from \$150,000 to \$200,000 worth of gold. The most of the gravel here is obtained by drifting from the bottoms of shafts sunk to no great depths; water for washing being obtained from the Natoma Ditch Company.

Since the suppression of hydraulic operations, but little mining has been carried on at Michigan Bar, where formerly an annual production of about \$150,000 was made by the five or six companies working there. One of these companies, the owners of the Amador and Sacramento Canal, have located in that vicinity 1,700 acres of auriferous gravel land, from which for ten consecutive years they washed out over \$35,000 per annum. Through the stopping of hydraulic mining this company loses not only the use of their improvements and land, but also in a great measure, the use of their water.

SAN BERNARDINO COUNTY.

The various mineral districts in this, the largest county in California, are scattered over a vast extent of territory, the most of it barren, timberless, and arid in the extreme. The

earliest mines found in this county, consist of the Holcomb Valley placers, discovered in 1861, and worked for several years, producing a large amount of gold. They are situated by the traveled road about 90 miles northeasterly from the town of San Bernardino, in an irregular shaped valley or basin, on a high range of mountains. There is no water for mining purposes except during the melting of the snow, here a limited season. The mines were worked principally by rockers. The ground in the outer part of the basin is shallow, growing deeper towards the centre until it is of a depth of 75 or 80 feet. Mining was done on all sides of the basin, working in towards the centre, until water was reached at a depth of from 10 to 15 feet, when further work being impracticable, the mines were almost entirely abandoned. There are several hundred acres of placers remaining, rich in gold. When water is brought to the ground, a large output may be expected. Some years ago, three or four quartz mills were running in this valley, and considerable bullion was produced, but work is now suspended. In Bear Valley, a few miles from Holcomb, are extensive deposits of gold quartz, but they are not worked at present.

Lone Valley, Eagle Mountain and Dry Lake are districts lying off in the deserts to the east and northeast of Holcomb Valley, organized many years ago, and in which there are numerous gold and silver bearing ledges, some of which have been located and extensively worked, but have never turned out much bullion, both because the ores have generally been low grade, often base, and because of the difficulty of carrying on mining operations in a region so remote and desolate.

In 1868, the mines in the Ivanpah district, lying on the northern boundry of the county, were discovered, and work on them commenced. They are distant 110 miles from Daggett, the point on the Atlantic and Pacific rail road from which supplies are hauled. These mines have been worked more or less ever since their discovery, and although the expenses have been heavy the value of the product has left

some margin for profits. The ores are chlorides and sulphites of high grade. The veins are very small, occasionally opening into large ore bodies. The country rock is limestone. The greatest depth reached in any of the mines is about 300 feet. Five mines in the district have produced bullion for several years past.

There are two mills in this district, one of which, with 10 stamps, has been run regularly during the past year, crushing about 20 tons per day.

Not, however, until the mines in the Calico district, discovered in 1881, began to produce, did the bullion output of this county amount to much. Since that time the product of bullion, consisting mostly of silver, has been increasing year by year, until it reaches now over three million dollars per annum.

These mines lie about 90 miles in a northeasterly direction from the town of San Bernardino, on the line of the Atlantic and Pacific Railroad. They are situated in a low, detached mountain that rises abruptly to a height of 600 or 700 feet above the surrounding plain. Its surface is bare rock, and broken by high abrupt cliffs and deep narrow chasms. It has the appearance of having once been a much higher mountain, now broken up and almost buried in its own *debris*. The trend is northwesterly and southeasterly. The principal developments made here are in a belt of country five or six miles in length from east to west by two miles in width. The mineral bearing ledges are of two classes, vertical and horizontal. Some of the former have been worked to a depth of over 600 feet without any contraction of the mineral bearing rock or decrease in the richness of the ores. In other claims the metalliferous stratum is more than 200 feet wide and lies horizontally, the ore being in pockets. There are here about 25 mines sufficiently developed to be classed as regular bullion producers, and about 30 more that have been opened up enough to show the extent and value of the ore-bodies, besides several hundred locations that have not been prospected sufficiently to determine their value.

One of the greatest bullion producers thus far is the Oroo Grande group, comprising the Silver King, Calico Queen, Burning Moscow, and Little Bonanza. These mines all join and are of the same character. The greater part of the work has been done on the Silver King ground. There are in this mine six levels, of a total length of 4,150 feet, with 1,200 feet of cross-cuts, all showing mineral. A shaft has been sunk 110 feet below the lower level, and shows a continuation of the mineral. The ledge on the surface and for 30 feet in depth is spar, below that it is soft porphyry, and at the present depth, it is 150 feet in width. The ores are chlorides and easily worked. The mine is in good order and is systematically managed. About 45 tons of ore are extracted and reduced daily at the company's 15-stamp mill, located five miles from their mines and one mile from the town of Daggett. They contemplate building a railroad between the mill and mines, on which latter they are about to put up hoisting works.

The Oriental mines join the Silver King on the east. The total depth reached here is 500 feet, with about 300 feet of tunnels and cross-cuts. The company has a mill which is kept running, crushing about 35 tons per day and producing a large amount of bullion.

About Daggett, a mining town and station on the Atlantic and Pacific Railroad, are a number of promising and productive mines, of which the Cuba, owned mostly by Lieut.-Governor Daggett, is the principal. There are, also, near this place, a 5-stamp mill, owned by that gentleman, and sampling-works, the property of the Calico Mining and Reduction Company. The Cuba mine, which affords very rich ore, is worked successfully by different parties, under tribute, who give one-fourth the net proceeds, after deducting expenses of hauling and milling, to the owner, this being the usual royalty exacted and paid by tributers in Calico.

The Garfield series of lodes, located about three-fourths of a mile easterly from the Silver King, comprises several of the most promising properties yet discovered in the Cali-

co district. This series, of which the Garfield, Occidental, and Thunderer constitute the principal, is owned by William Raymond and J. S. Doe, of San Francisco. The work of exploration is being conducted on the principal veins with system and thoroughness. Some important developments have already been made here, while indications point to the occurrence of others in the near future. A chamber of exceedingly rich ore having been opened up in the south end of the Garfield ground, an extension of the tunnel 1,500 feet west, brought to light a similar body in the Thunderer lode. A good deal of high grade ore has already been taken from these mines, nor has their productive capacity been put to any severe test. Work in the field is under the supervision of J. L. Patterson, an experienced miner, Mr. Raymond, whose judgment in mining matters is not surpassed, spending also much time on the ground.

The mill on the Silver Odessa mine, under the management of E. J. Murray, is making a notably large production of bullion for the amount of ore crushed and the number of stamps run.

The most of the ores throughout the Calico country belong to the chloride school, carrying sometimes a notable percentage of metallic and horn silver. They are for the most part high grade, and can be easily and cheaply worked. Under these conditions locators have been able to maintain themselves in the field and develop their claims without much outside aid. "Chloriding," as it is called, is much practiced here. By this plan, men of small means mine out such small quantities of the richer chloride ores as can be easily gotten at, and sell the same, or have them reduced at the local mills, some of which do this sort of work. Men who have no rich claims of their own, often work the claims of others on tribute, this style of mining practiced here tending to keep ready money in the camps. A good deal of ore from that region has been sent to the Selby Smelting Works, with results that promise to largely increase shipments to that establishment.

In view of all the circumstances, the short time that has elapsed since these mines were discovered, the prevailing low prices of silver, the little outside aid the district has had, and the large and profitable production of bullion that is now being made, it must be conceded that this Calico country has made a very creditable record, more successes having been made and fewer losses having occurred here to date than in any other mining district ever opened up on the Coast.

THE BONANZA KING MINE—LOCATION OF PROPERTY AND CHARACTER OF ORE BELT.

Far in the depths of the Mohave Desert stand what are known as the Providence Mountains, a rugged and lofty range having an easterly and westerly trend. Traversing the easterly slope of these mountains and at an altitude of 4,500 feet above sea level, is a broad metalliferous belt, the site of some of the most valuable silver bearing deposits ever found in California. These mountains are situated in the northeast part of San Bernardino County, at a point about midway between the town of Calico and the Colorado River. On this belt, which has been traced for a distance of seven or eight miles, are located the mining grounds of the Bonanza King Consolidated Mining and Milling Company, these grounds occupying a section of this belt over one and one-half miles in linear extent. The geological formation of the country here consists of porphyry and limestone, the mineral bearing belt, which stands at the line of contact between them, being composed of dolomite. In this dolomitic rock the ore bodies occur at irregular intervals, a heavy band of ore extending also along both the foot and the hanging walls.

THE DEVELOPMENTS MADE HERE

Consist of a vertical shaft sunk in the mineral belt to a depth of 500 feet and a 300 foot tunnel connecting with it,

and of 8 levels, driven from the shaft and united by winzes, a great extent of drifts having been run in various directions. The shaft put down here has required no timbering except a few sets put in at the several stations, the nut pine that grows in the neighborhood having answered the purpose. This material has also served for timbering the interior of the mine, where but little support has been called for.

THE PLANT ON THIS MINE

Is composed of a 10-stamp mill and powerful hoisting works, both driven by steam. This mill is supposed to be as complete in all its appointments as the present condition of the mechanical and metallurgical arts could make it, nothing that promised an economy of labor or a closer working of the ore having been neglected. As a consequence, exceptionally good results have here been reached, the daily crushing amounting to twenty-four tons, and the ore, though not very tractable, being made to yield under simple mill process, 88 per cent. of the precious metals it contains. While such close working of this somewhat stubborn ore is so attributable in part to the excellence of the mechanisms employed, it has been more largely due to the superior skill of the metallurgist in charge, than whom there is not a more fit or capable man in California.

The mine being perfectly dry, no pumping gear has yet been required, nor is it likely that any will be till the workings have been carried to twice their present depth.

THE ORE HERE

Occurs in a zinc blende and carbonate and silicate of zinc, accompanied with carbonate and sulphide of lead, rendering it rather difficult to treat. It carries on an average something over 50 ounces of silver to the ton with a very small percentage of gold. The tailings, though of little value, are saved for future treatment.

THE PRODUCTION

Made during the two years the mill has been running amounts to a little over \$1,500,000, out of which, after meeting all current expenditures, the original cost as well as the expense of opening up and equipping the mine has been paid, and \$200,000 disbursed in dividends to the owners, all of whom reside in the East. This mine belongs to a few persons who intend to hold and work it on its merits, none of the shares having ever been offered for sale. From present indications the above production can be kept up here for a great many years, large bodies of ore having been developed in the mine, and there being many others similar to those now being worked within the limits of the company's grounds.

The ore bodies here occur in the form of chutes or chimneys of great size, all of which carry their ore from the surface down. Five of these chimneys are known to exist and there may be still others on the Bonanza claim.

WOOD, WATER, CLIMATE, ETC.

This company employs about 130 men, teamsters, wood-choppers, mechanics, etc., included. The ore has to be hauled two miles from the mine to the mill. There is enough pinion or nut pine within easy reach to serve the purposes of fuel and timbering for a long time. Though water in the neighborhood is rather scarce, there is enough for present requirements. The country for a great distance around is exceedingly dry and barren, there being no running water, and only a few small springs, the only things of value found in the vegetable world consisting of a scanty growth of bunch grass and nut pine. The climate is healthful and pleasant, no extremes of temperature being ever reached. But little rain ever falls here and scarcely any snow; hence outdoor work is not much interrupted by inclement weather.

The Bonanza King mine is situated in the Trojan District at a point 22 miles north from Fenner's station on the Atlantic and Pacific Railroad, from which a good wagon road leads to the mine. There are at present but few people in the district outside the employees of this company. A number of other claims have been taken up, both on and outside the main mineral belt, but very little work has as yet been done upon them. Some of these, however, are said to show very good prospects.

Since the above was written, the destruction of the mill of the Bonanza King company by fire, has compelled, for the time being, a suspension of active operations on the mine, only enough men being retained to keep the property in order, till such time as a new mill can be put up; it being the intention of the company to erect another and, perhaps, larger establishment than the one so completely obliterated by the all-devouring flames; albeit this was a well equipped and expensive structure, its original cost having approximated \$100,000. This loss, though severe, will not at all embarrass the company, which is made up of men of large means, and as their past action shows, an energy and enterprise not likely to succumb to even a greater disaster than this. On an early resumption of active operations at this mine, the very life of the camp, and indeed, of the entire district, is wholly dependent.

SAN DIEGO COUNTY.

Some twenty years ago, the discovery of numerous gold-bearing lodes in the Julian district, situated in the mountains 40 miles easterly from the city of San Diego, attracted many prospectors to that locality. Gradually, however, the most of these left, only a few of the ledges discovered affording any large quantities of ore, some of the ore taken out failing also to stand such practical tests as arrastra and battery working. Not however did all of these adventurers go away. A few remained, and have during all these intervening years

been doing a little work, taking out limited quantities of ore and reducing it, mostly in arrastras, one or two of the several small mills put up in the district having also been kept running part of the time. Nevertheless, the product of bullion made in this the principal mining locality of San Diego County has been inconsiderable, having never amounted to more than \$100,000 per year, the annual output being at the present time even less than that.

Recently some improvement in mining is reported in the various districts of this county, of which, besides the Julian, there are several, viz: the Banner, adjoining the Julian on the east, with a 10 and a 5-stamp mill, running part of the time and making a small production of bullion; the Shenandoah, north of the Julian, with one 5-stamp mill, of late kept steadily at work and taking out a fair amount of gold; the Panacate, 80 miles north of San Diego, two 5-stamp mills and several arrastras, running off and on and doing moderately well; the Rattler, far out on the Colorado desert, one 5-stamp mill, also doing fairly, and the Ogilby, near Yuma and not far from the line of the Southern Pacific Railroad, no mill and not much development but numerous large ledges reported rich in free gold. The Cargo Muchacho mine in this district is probably the site of the first gold discovery ever made in California, this event having occurred over one hundred years ago. Placer mining has been going on at this place for many years, and but for the scarcity of water, large wages could now be made there washing the dirt in rockers. Quite recently a quartz ledge has been uncovered in these diggings that is said to assay at the rate of \$1,000 per ton, and which worked in arrastras yields \$75.

That there is a considerable extent of auriferous territory in San Diego County admits of no doubt, but most of it being in remote and desert regions, has heretofore been difficult of approach. Now that the railroads are rendering these districts more accessible, it may be expected that greater attention will be given to mining there, and that the business will be attended with better results, growing per-

haps in the course of a few years into one of pecuniary importance.

SHASTA COUNTY.

Mining, for the past few years, has been very active in Shasta County, more especially the prospecting and locating branch of the business. Meantime, there have occurred here some marked successes, with more partial failures.

A very rich deposit of the teluride of gold was discovered last summer near the line of the California and Oregon railroad, at a point a few miles north of the town of Redding. The fortunate strike was made by Peter Schearer, a tyro at the business. Nevertheless, it was not the result of mere accident, the finder having been guided to the spot by an old prospector, and encouraged to go to work there and search after the ledge that had enriched the gulch below, and which he was satisfied existed somewhere in the vicinity indicated. Working together for six months, the two came upon the treasure they were in search of, which turned out to be much more valuable than they had expected or dared to hope for. A good deal of the ore found here contains as much as \$1,000 worth of gold per ton, it being possible to select pounds that assay at the rate of \$20,000 per ton. Being a refractory ore, such works have been put up at the mine as seem adapted to beneficiate it effectually. This strike, having incited to much prospecting in the neighborhood, similar deposits, but none so large or extremely rich as this, have, according to report, been discovered.

Reviewing briefly the records of the more prominent mining districts of Shasta for the past few years, there appear the following salient facts: During this time several properties have been sold to outside capitalists and mining men, some of which, having since been equipped with plant and worked, have proved satisfactory to the purchasers; in a few instances the reverse has happened. A good many mines have been bonded, some of which, after further ex-

amination, have been accepted, though more have been restored to the owners. That the bullion product of the county has not kept pace with the general activity displayed, is due to the fact that the new mills and reduction works put up have not yet turned out much bullion; having only recently got to work; next year the results will be more telling. The mineral resources of Shasta are varied and extensive, consisting of numerous heavy deposits of gold, silver, lead and copper ores, with ferruginous beds of great extent. The county abounds with fine forests, is well supplied with water, and enjoys the further advantage of railroad communication with San Francisco, making it possible to get in machinery and other mining supplies at small cost and at all seasons of the year.

SIERRA COUNTY.

Sierra is entitled to take high rank among the mining counties of California, not more for what it has accomplished than for what it is capable of doing, the whole territory bristling with such opportunities for successful endeavor and the profitable investment of capital as are not excelled in this or any other county. That these opportunities are so little availed of is of easy explanation, having been due mainly to the diversion of home capital and the mining population to outside localities during the several excitements that have at different times prevailed in California; no section of the state having suffered more from these insane movements than Sierra County. The past few years have, however, done much towards repairing this damage, population having been on the increase, while money has been going pretty freely into the mines there. Noting, for instance, the progress made in the Sierra Buttes district, we find a number of large quartz mills have during this period been put up there, some of the mills before on the ground having meantime undergone enlargement. Many new mining locations have been made and much exploratory

work has been done on both the new and old, not a few of them having been developed into first-class prospects, and some into largely productive mines. And the work goes on; what has been done giving such satisfaction that it encourages to the undertaking of new enterprises and the performance of additional labor. Nothing denotes the prosperous state of affairs here more clearly than the fact that the output of bullion has for several years past been steadily on the increase, notwithstanding the hydraulic mines have all been closed down.

THE SIERRA BUTTES MINE.

A specially noteworthy matter connected with the recent progress as well as with the past history of this county, is the manner in which the Sierra Buttes mine, commencing more than thirty years ago, has been able to keep up a large, steady and profitable bullion production ever since; illustrating what, under a thoroughly good management, can be accomplished, even where the ore to be handled is of average low grade, and some of the other existing conditions not altogether favorable. The elements of success were here, but they had to be wrung out of rather stubborn surroundings. This mine is situated at a great altitude, where the snow-fall is deep and the winters are severe. It lies on the steep acclivity of a rugged mountain, the surface everywhere being rocky and broken, rendering the construction of wagon-roads and buildings, and the placing of machinery difficult and costly. The freighting in of machinery and supplies is expensive, there being long wagon transportation between the mines and delivery point on the railroad. And yet, in spite of all these obstacles, there has been worked out here a great success. The Sierra Buttes stands to-day, in so far as intelligent, persistent and well directed effort is concerned, among the very best conducted quartz milling enterprises in the world.

Beginning in 1851, at the very incipency of quartz mining in California, the business here has gone on expanding year

by year, until it has reached its present large proportions and great perfections, having proved self-sustaining all the while. From the primitive arrastra, the next step was to the crude stamp mill, which, as reduction requirements increased, underwent steady improvement and enlargement, the final outcome being the incomparably complete Yuba mill now doing duty at the mouth of the main tunnel on this ground. As with the milling arm of the service, so with the work of exploitation. It, too, was advanced by feeble stages, progressing from the open cut to the shaft; then came the short tunnel followed by others of greater length, no less than nine of these adits having been driven here, the last, longest and lowest of the series, being a very costly structure. Even the labor force employés have been promoted according to merit. Men, as they have shown themselves deserving, have been advanced from subordinate to higher positions in the company's service, this unfolding process having been closely adhered to and of general application.

It is not our purpose, because it is not necessary, to describe here with much fullness, the mine, plant and other improvements of the Sierra Butte's Company, this having so often been done in the various reports of the United States Commissioners of Mining Statistics, and through other reliable channels of information. Presenting a few leading facts on this subject, followed by a statement of what the company has accomplished during the first half of the present year, as gathered from the recent report of the board of directors, in London, will, perhaps, be all that in this place is required.

Premising then, it may be remarked, the series of veins that constitutes the mine of the Sierra Buttes Company traverses in an easterly and westerly direction a high ridge that makes down the southerly slope of the Sierra Butte mountain, an isolated, pinnacled peak, in the Sierra Nevada Range. These veins, which lie within less than 100 feet of each other, occur in a metamorphic rock, dip towards the north at an angle of about 45° , and show such a general

convergence, as makes it probable that they unite and form a single vein in depth. The presence of certain fissures and counter-seams, renders this system of veins somewhat complicated in the upper workings. In the deep, however, conditions become strictly normal.

The ore here is a free milling quartz that yields up 75 to 80 per cent. of the gold it contains by the most simple and inexpensive treatment. In practice it is crushed with stamps and the pulp amalgamated in the batteries with quicksilver, and then passed over copper silvered plates. It carries about one per cent. of sulphurets, the concentrates being worth \$150 per ton. The reserves in this mine clearly established and available for removal are large, while the undeveloped but probable resources may be expected to greatly exceed the ore that has already been extracted or brought to sight. The Sierra Buttes mine has been exploited by a series of tunnels, nine in number, the whole being connected by means of shafts, winzes, cross-cuts, and extensive stopings. Eight of these tunnels, starting on the easterly face of the high ridge mentioned, have been carried in on one or other of the lodes and on different levels for distances varying from 700 to 5,000 feet; the lowest being more than 1,000 feet vertically below the crest of the ridge, nearly 2,000 measured on the pitch of the vein. Three years ago tunnel No. 9 was started from the southerly base of the mountain, at a point as low down as practicable, the North Yuba river running only 100 feet below its level. This tunnel has since been driven to the lode, a distance of 7,000 feet, opening it up to a vertical depth of 1,700 feet below the highest croppings on the ridge. Although this structure has involved an expenditure of \$115,000, it will work economies that in the end will pay its costs many times over.

The plant here consists of two crushing mills, the one carrying sixty and the other fifty stamps, together with extensive chlorination works for treating the sulphurets. The larger of these mills, the Yuba, located at the mouth of the

lower tunnel, comprises in its outfit all that is most recent and advanced in the business of quartz reduction in California. Wherever machinery could be substituted for manual labor or be made to assist the latter, this has been done. The cars, running from the tunnel by their own momentum, bring out the ore, and carrying it into the mill at the very top of the tall building, dump it on the grizzlies, the fine ore going through to the self-feeders, while the coarser is conducted to the rock-breakers, to be reduced to the proper fineness, after which it too is sent to these feeders, which supply it steadily and evenly to the batteries. From the latter the pulp, flowing over the galvanized copper plates, passes on into the concentrators. These machines, separating and saving the sulphurets, reject the tailings, which the water carries down the cañon out of the way. In all this vast establishment hardly more than a dozen men are ever to be seen, this being quite as many as there is any need for. The machinery here is all run by water, two hundred inches delivered on a turbine wheel under a head of 550 feet, sufficing for the purpose. This head, if necessary, can be increased to 1,500 feet. This mill, which has a crushing capacity of 4,500 tons per month, cost, tramway, hoisting and chlorination works included, \$100,000. For concentrating the sulphurets thirty Frue machines are employed, these being considered the best in use. The 50-stamp mill, known as the Hitchcock, located near tunnel No. 7, has not been run for the past few months, its elevated position making it difficult to supply it with ore.

During the last fourteen years there has been taken from this mine the gross sum of \$2,000,000, of which \$1,360,288 has been disbursed to the shareholders in dividends; no assessments have ever been levied on the shares. In 1883 31,580 tons of ore were extracted and milled, yielding an average of \$6.70 per ton; cost of mining, dead work included, \$4.97; cost of milling, 50 cents per ton; results reached in 1884 having been not very different. During the first six months of the present year the output of ore amounted to

29,243 tons, which yielded \$189,196; average yield of the ore, sulphurets included, was \$6.47 per ton; cost of mining, \$3.85, and of milling, \$0.45 per ton—total, \$4.30. The number of men employed in the mine and mills averages about 250.

The Sierra Butte ore, as will be seen, is of rather low grade, the average yield for the past ten years having been only about \$7 per ton. It might, of course, have been assorted to a higher grade, some of the poorer quality being rejected. And this, had the mills in use been of limited capacity, might have been the proper course to pursue. But it has been the policy of this company from the first to reduce everything that would afford any profit, however small, supplying milling facilities adequate to that end. By this plan the life of the mine has been prolonged, while it has been made to yield up all there was in it. Great benefits would have accrued had this policy been more generally adopted by California mine-owners, who have too often sacrificed the life of their properties for immediate results. This Sierra Butte management has taught our people a lesson they would do well to heed. No commercial or manufacturing concern ever conducted its affairs more in conformity to strictly business principles than this company has done. All the careful forethought, attention to details, system and economy practiced by a first-class merchant seems to have here been observed.

The general manager of the Sierra Butte mine is Mr. William Johns; Hugh Marshall, local Secretary. Outside Superintendent of the mine, Thomas Preston; inside Superintendent, William M. James. The Board of Directors reside in London, where the head office of the company is located.

The Yuba mill was planned, and the work of its construction supervised, by George Woodward, a skillful and experienced mill builder. The head amalgamator at this mill is Mr. Joseph Carney, Albert Maltman having charge of the chlorination works.

PLUMAS EUREKA MINE.

This property, which is located in Plumas County, being owned by the same London Company and under the same general supervision as the Sierra Buttes, is here noticed more at length than was done in the article on that county.

This mine is situated near the town of Jamison, in the southern part of Plumas County, at an altitude of 7,000 feet in the Sierra Nevada mountains. It consists of four distinct locations, each containing a separate lode, the principal vein, the Eureka, being from 4 to 20 feet thick; its average thickness about 6 feet, the others being of somewhat less dimensions. These veins strike northwesterly and dip to the north at an angle of 57° . A singular freak of vein formation occurs in this mine. At a depth of about 1,400 feet a portion of the main lode makes off almost horizontally in the foot wall, having a slight dip to the southeast. This flat lying portion of the lode is about $3\frac{1}{2}$ feet thick, and has been followed 200 feet without reaching the end. 300 feet further down another of these anomalies occurs, the seam here being from 2 to 18 feet thick and dipping slightly to the west. A section of it 250 feet square has been stoped out. Near the top of the mountain another of these irregularities occurs, this being less marked, the dip varying from ten to twenty-five degrees to the eastward in some places and to the southwest in others. This deposit has been followed 1,500 feet without reaching its terminus. Putting out from this is a branch, a section of which 250×400 feet has been stoped out. Above this again still another of these offshoots occurs, this last promising to be quite extensive. The presence here of these abnormal deposits is something that ought to interest the scientists. As above stated, some portions of these flat laying veins have been stoped out and sent to the mill, where they paid fairly. They would have been worked more extensively had not so much rehandling been required in getting them to the mill.

The method of exploitation adopted here is very similar to that employed in the Sierra Buttes mine, consisting of a series of tunnels, six in number, driven the one below the other. The Eureka, the lowest of these tunnels and the last one driven, has a length of 5,400 feet, and opens up the lode to a depth of 1,500 feet below the highest croppings. At the mouth of this tunnel is located a 60-stamp mill, driven by water, and obtained from a lake on top of the mountain above. This water is delivered on a turbine wheel and when insufficient to drive the mill steam is used. Two large shafts are being sunk from the bottom of the lower tunnel. For doing the hoisting here compressed air is used; both steam and compressed air being employed for working the pumps. A novelty in use here is a water engine, water under pressure performing the service that in other engines is performed by steam. The ore from the upper levels is sent down in cars running on incline tramways, the descending full cars drawing the empty ones up.

The 60-stamp mill of this mine is equipped with all the most approved mechanisms and appliances extant, a great deal of its work being automatically performed. Such economy of manual labor has been effected here, that eight men suffice to look after its entire operations. About 220 men find steady employment in the mill and mine. It has heretofore been the practice of the company to suspend work during the winter in the outside mines, as not much could then be done there to advantage, owing to the depth of the snow. During the past summer sheds having been built for protecting the miners while at work from the dangers and discomforts incident to these deep falls of snow, there will be no intermission of operations in these outside mines hereafter. Three thousand feet of sheds and tunnels have been constructed for the above purpose.

Mr. John Hoskins, Superintendent, reports 1,659 linear feet of tunnels, shafts, winzes, and cross-cuts run here during the first half of the present year, 27,789 tons of ore, yielding at the rate of \$7.27 per ton having meantime been

extracted and sent to the mill, the cost of mining and milling this ore having been at the rate of \$4.32 per ton. Without being especially flattering, the prospects of this mine may be considered tolerably good, there being little doubt but the present rates of production and net earnings can be kept up for a great many years.

THE YOUNG AMERICA MINE.

In the history of this district, lifted up by the great Sierra Buttes, no mine has come so rapidly to the front as the Young America, situated on the northerly slope of the mountain, at an elevation of two thousand two hundred feet above Sierra City, and seven thousand four hundred feet above the level of the sea. It is distant northeast from Sierra City two and a half miles in a straight line, seven miles by the wagon-road. Lying between the greenstone and the syenite, which here form the country, is a belt of metamorphic slate about two hundred feet wide. In this belt, which strikes west 17° north, occurs the Young America lode, a vein of quartz averaging six feet in thickness, and pitching north with the formation at an angle of 45° . The linear extent of lode taken up by the company, and for which a U. S. patent has been applied, comprises 6,000 feet. From the easterly slope of the mountain two tunnels have been carried in on the vein, the upper to a distance of five hundred and the lower of six hundred and fifty feet, a shaft connecting the inner extremity of the upper tunnel with the surface. A third tunnel has been projected on a level eight hundred and fifty feet below the second one. This mine lies at an elevation that will admit of its being opened by tunnels to a vertical depth of sixteen hundred feet. A short distance below the mine a 10-stamp mill has been put up, to which the ore is conveyed by means of a Hallidie elevated wire tramway. This mill is propelled by water, of which the company command enough to drive sixty stamps or more.

On the 7th day of September, 1885, the company, after a seventeen day run of their mill, cleaned up \$16,000 gold bul-

lion, the ore crushed having yielded at the rate of \$70 per ton, which not having been selected, is considered a fair test of what the mine will do hereafter. Should future crushings yield at this rate, the production made here will be something phenomenal, as the ore stock is obviously very large. The quantity of ore developed here is estimated at 30,000 tons, the showing in the lower tunnel being even better than in the upper. There is ore enough now on the dumps to keep the present mill running for five or six months. Mining and milling can be performed here cheaply, at a cost never to exceed \$4.00 per ton. By the first of November, twenty additional stamps will be running, doubling production without materially increasing current expenses.

The Young America is an incorporated company, the present officers being, president and treasurer, A. C. Busch; secretary, P. Deidesheimer, Jr.; superintendent, Oliver Saunderhaus; manager and agent, Philip Deidesheimer; trustees, A. Busch, Wat. Hughes, C. A. Herringlake, J. Saunderhaus and M. H. Mead.

THE MOUNTAIN MINE

Is supposed to be a continuation of the Young America lode east, being in the direct range of its strike, with only a small lake between, and the ore being of the same character. This claim, which is owned solely by Mr. Henry Warner, an old time resident of Sierra City, covers 3,600 feet on a broad ore-bearing belt, secured by a U. S. patent. This belt, which has a width of 200 feet, is filled with porphyry banded with slate, and in it occur the veins of gold-bearing quartz, five in number. The largest of these veins has a thickness of 15 feet, the others ranging from 2 to 4 feet in thickness, there being but little doubt but they gather up and form a single vein in depth. Should such prove to be the case, there will be opened up here some day a very valuable mine, as all these veins carry a notable percentage of free gold in the croppings as well as at all points where they have been exposed below. Four tunnels, one of them 450

feet long, have been run here, with some other prospecting work done. Appurtenant to this property is a mill site and a water right, the latter affording power enough to drive a mill most of the year. The ore could, however, be easily transmitted by wire tramway to the North Yuba river, where free water for motive power could be had in any desired quantity. The owner of this very promising property having opened it up and put it in good shape, would convey a liberal interest in it to any party who would outfit it with suitable reduction works, a proposition that ought to meet with ready acceptance on the part of those desirous of engaging in this line of business.

THE MARGUERITE MINE.

This mine and works are located at Logansville, two miles below and to the west of Sierra City. They are situated on the left side of the North Yuba, and immediately on the brink of the river. Not another mine in the district is so eligibly located as regards approach as the Marguerite, the great central thoroughfare of the county passing within a hundred yards of the mill. The vein here, which manifests its presence by a well defined line of croppings, conforms in strike and dip to the general system of the country.

A first-class 20-stamp mill, with hoisting and pumping works, was put up on this mine several years ago and operated for a time with good results. Owing, however, to trouble with the pumping apparatus, and a variety of minor difficulties, operations were much interrupted, and finally suspended until measures could be taken to obviate these troubles; among other needs a new and more powerful pump being required. The mine makes a great deal of water, the dip of the lode carrying it under the river. It was expected that everything would have been supplied and gotten in shape for a resumption of operations here some time during the past summer, but owing to delays caused in part by dissensions among the owners, this reasonable expectation has been disappointed, and it is now announced that the mill

will not start up again until next spring. The causes of such long interruption of work not being generally understood, has led many to suppose there was something wrong with the mine itself, which, however, is not the case. The property is inherently a good one. The lode, strong and fertile, occupies a true fissure, occurring at the line of contact between the two formations which constitute here the country. It is well stocked with high grade ore; a productive chimney 420 feet long and an average thickness of three feet having already been developed, although the work of exploitation has not yet been much extended. The ore milled yielded an average of \$17 per ton in free gold, besides one per cent. of rich sulphurets.

Appurtenant to this property is a franchise covering a portion of the flow of the North Yuba, so much of this water as is necessary being now used to drive the entire machinery on the mine. The power is transmitted from a turbine wheel for a distance of several hundred feet by a wire rope, and is ample to perform all the lifting required to a depth of sixteen hundred feet. Through the method of utilizing the water here in use, a great economy in working the mine is assured. Those having pecuniary interests in the Marguerite should, therefore, possess themselves in patience, as it is bound to come out all right in the end. There is little excuse, in so far as the management is concerned, for the recent hitch in the affairs of the company, whereby the starting up of the mill is to be postponed another four or five months.

THE PHENIX MINE,

Located about two miles northeasterly from Sierra City, covers a linear extent of about 10,000 feet on a strong, fertile vein of gold-bearing quartz, which in its course seems to strike into the Young America. This lode has an average thickness of eight feet, and carries at a depth of 246 feet, to which point it has been opened up with a shaft, a chimney of rich ore, 250 feet in length. A tunnel has been started

and is now being driven actively towards the lode which it will intersect at a depth of 300 feet. This work will be carried on steadily throughout the winter, it being the intention of the owners, all residents of Sierra County, to put up a 20-stamp mill on the mine next year. This mill will be placed on the river and be driven by water, the company owning a franchise to all that will be required for the purpose, besides operating the elevated wire tramway that will be put up for bringing the ore down from the mine to the mill. From the tests made it is expected that this ore will yield, under the stamps, \$20 per ton at least, besides the rich sulphurets, of which it carries about 2 per cent.

THE FLORENCE MINE,

Consists of a group of three different ledges, situated on the ridge south of the Yuba, and two miles from Sierra City. It has been opened by a tunnel 600 feet long, and shaft down 50 feet. The Florence lode, at the point where the tunnel intersects it, 200 feet below the surface, has an average thickness of five feet. The other two veins are about four feet thick at a depth of 20 feet. The ore here will mill from \$15 to \$20 per ton, some portions of it worked by arrastra having paid as high as \$70 per ton. These are east and west ledges, standing nearly vertical, the pitch being slightly to the north. The country rock is the same as on the north side of the river. A water power, ample to drive a 10-stamp mill, goes with the mine, in which there is ore enough developed to supply a mill of that capacity for a year or more. These ledges are advantageously situated for being opened by tunneling. The locality is of easy access and the country covered with the finest of timber. Arrangements have been perfected for carrying on work here steadily the coming winter, it being the intention of the owners to take in a 10-stamp mill in the spring.

THE COLOMBO MINE.

This mine covers a section of a broad and well-defined quartz vein lying on the same slope of the mountain with the Sierra Buttes lode, with which it corresponds in strike and dip. On this vein, the owners, encouraged by the rich prospects obtained from all parts of it, put up a 20-stamp mill some two years ago. After a season of success, extending over a part of two years, operations came to a temporary halt in consequence of the lode being faulted in the lower levels. Meantime, search is being made for the ore body so displaced, which will eventually no doubt be recovered, as the vein is a strong one and keeps its course far beyond the point of disturbance. While this interruption is vexatious to the management and financially damaging, no one has lost confidence in the mine, these breaks occurring often in the most regular and deep fissured veins. It is expected that ore extraction will be resumed here before long, every part of the mine and works having been kept in complete order during this interregnum in bullion production. It having been found that their tunnel would afford water enough to run the mill when ready to start up again, the company in September last disposed of their engine and boilers to the owners of the American Hill mine, over near the Middle Yuba, to which it has since been removed.

THE ALASKA MINE.

This property, situated at Pike City, standing on the ridge overlooking the Middle Yuba on the north, deserves to be classed among the best mines in the state. The lode here is no doubt a continuation north of the Spayth and Stranahan series of veins, striking accross the San Juan ridge to the south, as already described. Though an old location, and worked in a limited way for some years, not until recently did the Alaska begin to distinguish itself as a bullion producer; and when it had first got to work, showing its capabilities in that direction, a fire occurring in the early part of

1883, burnt up the hoisting works, delaying operations for several months. This disaster repaired, the mine resumed its prosperous career which has been continued to the present time. The claim embraces 4,000 feet on a regular 4-foot lode, encased in slate walls. The main vertical shaft, 19 x 7 feet, three compartments, having reached a depth of 475 feet, drifting on the lode both ways, an entire distance of 2,500 feet, has disclosed three ore chimneys carrying an immense quantity of high grade, free milling quartz. These chimneys, which seem likely to unite below and form one great ore body, have been steadily worked for nearly two years, the daily output of the mine having averaged 35 tons, which, under the stamps, has yielded \$25 per ton. Besides sending to the mill its daily supply, a single shift on one occasion last year, took out as much as \$30,000 worth of specimen ore.

Encouraged by the developments made and the prospects ahead, the company are about to add to their present 20-stamp mill another of equal capacity. In the main shaft a Worthington pump, capable of lifting to the surface 1,000,000 gallons per day has lately been placed. This is being done as a precautionary measure, the management not caring to run the risk of having operations delayed by any accident that might occur to the present pump. There is also danger that the latter may not be able to handle all the water in the event of any considerable increase, as is likely to happen, this being an exceedingly wet mine. A large number of men are kept employed here, the force ranging from 100 to 150, it being the policy of the company to keep dead work well advanced; a good many wood choppers, teamsters, &c., being also required, the machinery here being run by steam.

Although everything in and about this mine seems to the inexperienced eye as complete as possible, Col. E. P. Bates, the experienced and capable superintendent, contemplates other improvements, entertaining a purpose to make it a model of efficiency and thrift as well as a notable producer of bullion. The underground workings of the mine are in

charge of Mr. Frank Gluyas, also a miner trained to the business. Between these two very competent men, the affairs of this opulent mine are being administered superlatively well.

VARIOUS OTHER QUARTZ MINES.

In addition to the foregoing quartz mines that have been running in this county during the past two years, the most of them quite steadily and successfully, we note the following: On the Four Hills mine a tunnel intersects the vein at 150 feet, giving 100 feet backs. The ledge here has a width of forty feet, all of which will yield \$4 ore. A streak of this ore worked in a 10-stamp mill, pays seventeen men fair wages. The Honeycomb quartz lode, near Camptonville, idle for several years, has been reopened and made crushings with a 5-stamp mill that paid at the rate of \$18.50 per per ton. The Gold Bluff lode, near Downieville, worked with a water-driven arrastra, has given steady and profitable employment to seven men for the past year or more. The Lamping mill has been running on Good Hope ore of fair grade. Several large arrastras have been crushing ore from the Oro and the York mines, in Slug Canyon, and doing extremely well, an 8-stamp mill erected on York mine having been in operation since February last. The ore taken from the Belmont quartz lode at Poker Flat has paid large wages crushed in a hand-mortar; the deposit is likely to prove astonishingly rich.

On the Kentucky lode, an extension of the Sierra Buttes, a tunnel has been run that gives 150 feet backs, and a flume built to bring water from the Yuba to drive a 10-stamp mill. The vein here has an average thickness of 30 inches, and carries a high grade ore, some of which has been worked with excellent results. The American Hill quartz lode, eight miles above Minnesota, has been actively worked a part of the time, and is looking extremely well. The owners, feeling warranted in putting up a 20-stamp mill on the property, proceeded with the work during the past summer, and pushing it vig-

ously, have now a well appointed establishment about ready for duty. The engine and boiler for this mill was bought of the Colombo company, who had no further use for them, having substituted water in place of steam for a motive power. The outlook at the American Hill mine is said to be full of encouragement. At the Rainbow mine, on Kanaka Ravine, below Chipps' Flat, the long tunnel designed to open up the lode at a greater depth, having been completed, an uprise is in progress, with a good prospect of recovering the rich ore body developed above, but which seems to have suffered some displacement further down. It would prove especially gratifying to the mining public to see this once productive mine restored to bonanza, the owners, Messrs. Noble, Grove and Hanley, having expended a large sum in running this lower tunnel, a work undertaken in the interests of legitimate mining. Every effort made at proving our quartz lodes in depth, is a matter of vital concernment to the public, the life of this branch of mining depending upon the persistence of these lodes in depth. At the old mining camp of Minnesota, Isaac Boles has continued prospecting that portion of the Plumbago quartz belt belonging to him, striking occasionally one of those rich pockets for which his claim has long been noted. This, however, is a property that ought to be owned by a rich man, who could afford to take the chance of losing a little money with the almost equally good chance of adding largely to his wealth. In the same neighborhood, Captain Irelan, of San Francisco, has been prospecting some quartz locations that he has long owned there, and which there is reason to suppose possess much solid merit. On the Hope claim, occupying 3,900 feet patented ground at the northerly end of the Plumbago belt, not much has been done for

- the past year or two, the owners awaiting an opportunity to sell or have a mill put up for a part interest in the property.

DRIFT MINING IN SIERRA COUNTY.—THE BALD MOUNTAIN MINE.

While the product of this mine, notably large in the past, has fallen off considerably during the last two years, it has still been able, under its old and excellent management, to make some net earnings; nor is it by any means certain that its resources are yet exhausted. During the year 1884, the company kept from 50 to 100 employed, according to the water supply. Operations that year consisted in removing the pillars left in the old drifts and in working some ground rented from their neighbors, all of which proved fairly remunerative, about 100 ounces per week having been cleaned up during the early part of the season. Towards the end of the year the exploratory labors of the company were rewarded by the discovery of new gravel deposits lying under the lava, below their old workings. From this new find about \$60,000 was taken, when work here was suspended owing to the expense of raising the material to the tunnel above, for which an engine had to be employed. For the removal of this gravel a new tunnel on a lower level will be driven, should the deposit on further examination seem to warrant the same. That it will prove rich and extensive there seems to be pretty good evidence. Meantime, the company have continued to employ only about 40 or 50 men, who are kept busy extracting such gravel as has been left in different parts of the mine and pushing the work of exploration in new directions.

The property still remains under the supervision of Senator Wallis, who has managed it so honestly, skillfully, and successfully from the first. There has been taken from this claim to date, close upon \$3,000,000, nearly half of which, consisting of net profits, has been disbursed to the shareholders in dividends. The original investment here amounted to no more than \$20,000, contributed by an association of working miners, and mostly in the shape of labor rendered by the individual members, 20 in number.

THE WALLIS GROUNDS,

Situated on the ridge above Forrest City, comprises 1,300 acres of land covering, as is supposed, a long stretch of rich gravel channels. For the purpose of opening up and working this ground a tunnel was commenced in May last, and the work being in experienced and competent hands, will, it is expected, be pushed to a speedy completion. The chances of striking rich deposits here, and within a reasonable distance, are considered extremely good.

THE BALD MOUNTAIN EXTENSION.

After much time and money spent, this company reached pay gravel in their ground some two years ago. Owing to the occurrence of lava flows, cutting off portions of their channel, no very large or profitable production was made until about one year ago, when an uprise brought them into a channel that prospected well in gold; whereupon preparations were made for working it on an extensive scale. An incline in the lava 240 feet long, was run up from the tunnel, and machinery so arranged that the descent of the loaded cars take up the empty ones and the necessary timbers, etc. A pipe has been put in to carry the water out of the mine, and another to bring in air. The breasts have also been opened, and gravel taken out through the upraise. The cars are drawn in and out of the 6,000 feet of tunnel by horse power. The channel now being worked is believed to extend for miles. Should this prove to be the case, as it no doubt will, it assures for the mine a long life and a prosperous career. Anticipating such result, it becomes almost matter for public congratulation, because of the encouragement it will afford the many other companies engaged in the laborious and costly business of opening up these gold bearing channels, so buried deeply under the bassaltic mountains. This company have fairly earned the success that seems now to await them, having taxed themselves heavily year after year, never faltering or losing faith in the enter-

prise, though the lamp of hope sometimes burned pretty low. The following are the names of the men who have stood by each other so faithfully, and shown so much financial nerve during all these long years: H. T. Briggs, President of the Company; J. W. Orear, Secretary and Treasurer; Walter Lawry, Superintendent of the mine; H. H. Purdy, S. B. Davidson, R. Forbes, and M. H. Mead, all residents of Downieville.

Several other drift companies are running tunnels for gravel in the vicinity of Forrest City, but as yet only the Ruby have reached pay deposits. This company have been extracting gravel for several years, and have taken out in the aggregate a great deal of gold. But the deposits have proved so spotted as to render the product uneven, and the business perhaps not very remunerative.

Over in the northwestern part of the county, a number of drift claims are being successfully worked, one of them,

THE NORTH AMERICA,

Located at Hepsidam, having distinguished itself for its large and profitable production, kept up for the past ten or twelve years. This mine, which at the start was opened up and equipped in splendid style, has been very extensively worked, the main adit, over a mile in length, passing clear through the high ridge in which the deposits occur, and which forms the boundary line between Sierra and Plumas counties. How much gold has been taken out here cannot well be ascertained, as the company, composed of three or four individuals, keep their business well to themselves, though it has probably reached and may have exceeded a million dollars. The property has always been under the exclusive management of Miles Schofield, a man of business habits and a thorough going miner.

Extending along the west side of the State Creek basin all the way from Hepsidam down to La Porte, the country is traversed by numerous rich gravel channels, constituting this one of the best drift-ranges in the State. As this region

was the site of the earliest drift operations carried on in California, then by small companies and individual miners, so is it likely soon to become the theatre of large enterprises and heavy investments.

Besides the operation of these larger companies the usual amount of work, and with about the usual results, has been done the past year in the following drift mines in this county, viz., the Union, at Gibsonville, from which some very rich dirt was taken; the Lincoln and the Empire, at Howland Flat; the Morgan and the Donahue, and Cox, at St. Louis; the Caledonia, at Ceder Grove; the Queen, at Port Wine; the Mountain Boy, at Bunker Hill; the Pioneer, at Grass Flat; a number of small claims, perhaps a dozen in all, have been worked about Scale's Diggings and Fir Cap, and two or three at Poker Flat. A good deal of river-bed mining has been carried on the present season along the North Yuba, a large part of it by the Chinese. This class of miners have been very successful, the water in the river having seldom been so low as during the present fall. Since the closing of the hydraulic mines several attempts have been made to work this class of claims by drifting, while some of these attempts have been attended with success, more have proved failures.

SISKIYOU COUNTY.

Every branch of gold mining has been fairly prosperous and slightly on the increase in this county for the past year or two. The present has been a specially good year for river-bed mining, largely practiced here. But little snow having fallen on the mountains last winter, the water in the rivers fell to a low stage early in the summer, enabling the river-bed miners to commence work fully a month earlier than usual. As there have occurred no premature rains this fall to raise the rivers, these miners have had a long working season, and generally done well. The principal localities of this class of operations are along the Scott,

the middle Klamath and the Salmon rivers, where for more than 20 years they have been prosecuted on an extensive scale. This low stage of water, while it has so favored the river-bed miners, has proved detrimental to the hydraulic branch of the service, the efficiency of which depends largely on an abundant water supply. With this class of miners, therefore, the working season has been correspondingly short, this water dearth having now extended through two summers. But notwithstanding this drawback the hydraulic miners along the Klamath, by reason of the generally favorable conditions that there obtain, clean up every year a great deal of gold. Being able to carry on operations at little expense, the net profits on the total production made are apt to be large.

Quartz mining in Siskiyou has also been pretty well prospered; Cottonwood, Indian Creek, Oro Fino, and Liberty districts, having been the sites of greatest activity in this branch of mining.

Operations on the Black Bear mine, in Liberty district, partially suspended two years ago, have been resumed, a small force of hands having been put to work on the mine the past summer. In the month of October of the present year, the mill was started up again and it is reported that a good body of ore has lately been developed in new ground of the company.

STANISLAUS COUNTY.

In the early days a good deal of placer mining was carried on in this county, mostly along the larger rivers, where still the Chinese make small wages working over the tailings. A few whites also continue to work placer claims, mostly along these streams. Hydraulic operations, formerly carried on extensively at La Grange, having been enjoined, this branch of mining is no longer practiced in the county. A 10-stamp mill put up in 1879 on a quartz lode, four miles from this town, having shut down after a short run, has so remained

ever since. At a point ten miles east of La Grange a mill running on ore from the Daisy mine, is said to be doing remarkably well; and this includes about all the mining now being done in Stanislaus County.

TULARE COUNTY.

At White River, in the southern part of this county, occur numerous small veins of gold-bearing quartz, some of which have been worked for as much as 30 years, mostly with arrastras. The ore being rich and easily gotten out and reduced, these mines have paid remarkably well worked in a small way. As these veins lie quite flat very few of them have been opened up to a greater depth than 20 or 30 feet below the surface.

In the Mineral King district, situated on the westerly slope of the Sierra Nevada, at an altitude of 7,000 feet, occur a number of large sized silver-bearing lodes, upon some of which a good deal of work has been done. The ore from these lodes has been worked in arrastras, but no large production of bullion has ever been made. But little has been heard about this district of late, rendering it probable that not much has meantime been done there.

TUOLUMNE COUNTY.

Whilst quartz mining, for many years much depressed, has of late undergone considerable improvement in this county, the other branches of the business show little or no improvement. During the past two or three years a number of new mills have been built there, some of the old ones have been overhauled and started up, and nearly the whole would appear to be doing moderately well. Pocket mining, in the prosecution of which a number of very rich strikes have been made, mostly in the vicinity of Columbia and Sonora, still continues active, and still meets with occasional large reward. Not much drift mining is being done, though a few

claims of this kind are being worked under the Table Mountain. Some river-bed operations are also in progress, hydraulic washing having, of course, ceased altogether.

Near Reynold's Ferry, on the Sanislaus river, a company is engaged in constructing a tunnel through the narrow neck of a low ridge not exceeding 1,000 feet in length. The river here forms a horseshoe some two miles round. It is proposed to turn the entire water of the river through this tunnel during the summer season. This will drain the river-bed the entire distance of at least two miles, after which the mine can be worked to advantage.

TRINITY COUNTY.

While quartz mining has, during the past few years, been making considerable progress in this county, every other branch of the business has remained nearly stationary. About twenty different hydraulic claims are run here, the most of them in a small way, though several are conducted on an extensive scale, and nearly all with a good share of profit. A species of hydraulic mining known as "booming" is also carried on to some extent in this county, being practiced where the water supply is limited. By this method the water is collected in a reservoir and let out with a rush, the receptacle after emptying itself being left to slowly fill up again, this process being wholly automatic. Among the larger hydraulic properties here is the Ward or Loveridge mine, on Oregon Mountain, the McMurray and Hupp, in Weaver Basin, the Hayes mine, near Junction City, and the possessions of the Trinity River Canal and Hydraulic Mining Company, belonging to the estate of the late Thomas Blythe, this property being elsewhere described in this book. The greatest drawback to hydraulic operations in Trinity has consisted in a limited water supply. There is plenty of water in the country but, as a general thing, it requires long and expensive ditches to introduce it upon the mines, and these, except in a few instances, have not been

built. There is also plenty of auriferous gravel here, much of it of good grade, most of the other conditions being also favorable; but with an inadequate water supply these are of little avail. When more and larger ditches are constructed, as some day they will be, hydraulic mining will come to the front in this county, though quartz operations will, in the end, prove the predominant branch of gold mining here. In their exemption from liability to be enjoined from running on account of damages done other interests, the hydraulic mines of Trinity, Klamath, and Del Norte, enjoy a great advantage over those located in the more central mining counties in the state.

The more important quartz localities are Deadwood, Bully Choop, East' Fork, Enterprise, and New River, the first named, so far as development and production go, being also the first in importance. This district contains a large number of quartz ledges that carry a fair percentage of high grade ore. A number of small mills have been put up here, some of them several years ago. They have all been running with little interruption, and the most of them making handsome net earnings. The New River country, which caused such a stir about the beginning of the year, is likely to show up some very valuable gold-bearing deposits, notwithstanding the discredit it suffered through the collapse of a premature excitement. Just now the sorest want of the district appears to be facilities for milling the considerable quantities of really good ore that have been extracted from the mines, only a 5-stamp mill and two or three arrastras having as yet been put up there. The most of the miners being without money and without means for working their ores, have been obliged to leave the country, their faith in the mines being unimpaired. The next time New River comes up it will be on its merits; and although this may require some time, the advance when made will be very likely to prove permanent.

YUBA COUNTY.

The closing of the large hydraulic claims in the vicinity of Smartsville, has very nearly extinguished the business of mining in Yuba County. The Chinese rewash the tailings and work over some of the old diggings, while a few quartz lodes, situated in the foothill region of the county are in process of development, with small mills running on three or four of them. The bullion product has shrunk to less than a quarter of what it was, the population engaged in mining having been diminished in nearly a like ratio.

MINING MISCELLANY, ETC.

PECULIAR DEPOSITS AND SPECIAL PROPERTIES
—GOLD BLUFFS AND BEACHES—WAGE EARN-
ING LOCALITIES—MINING MACHINERY AND
IMPLEMENTS—USEFUL MINERALS AND MET-
ALS—QUICKSILVER, NICKEL, IRON, BORAX,
ETC.

The following chapter is devoted to some notice of various matters and interests connected with the subject of mining, but which, because of their miscellaneous character, could here be disposed of more conveniently than in the preceding pages of the book.

THE ESTATE OF THE TRINITY RIVER CANAL AND HYDRAULIC MINING COMPANY.

The following somewhat detailed description of two extensive hydraulic mining properties, situated the one in Trinity and the other in Del Norte County, is here given, for the reason that they may be considered representative mines of this class in the northwestern section of the State, a region likely soon to become the field of the most extensive and successful operations in this department of mining.

LOCATION, EXTENT AND GENERAL CHARACTER OF PROPERTY.

The estate of this company is situated in Trinity County, California, at a point about thirty miles northeast of Weaverville, the county seat. It is distant 370 miles north from San Francisco, whence it is reached 320 miles by rail to Reading, and thence 50 miles by stage over a first-class wagon road. The estate comprises 3,707 acres of land, much of it

gold bearing, heavily timbered and well adapted to the growth of fruits of nearly every kind; together with a first right to a flow of 60,000 inches of water, the whole constituting one of the largest and most valuable mining properties ever aggregated in California.

This land, which is divided into 36 different tracts or mines, lies along and adjacent to the Upper Trinity River and its principal tributaries, Coffee Creek and the East Fork. The auriferous deposits here are of two kinds, hydraulic and cañon or creek-bed claims; the bars, gulches and other superficial deposits that once existed here, and all of which were rich in gold, being now mostly worked out.

CHARACTER AND EXTENT OF HYDRAULIC DEPOSITS.

This class of deposits, which, speaking in a general way, may be said to cover an area of 2,500 acres, consists of banks and beds of gold bearing gravel, varying from 50 to 400 feet in depth. The gold here being diffused throughout the entire mass of gravel, the latter can be advantageously worked only by the hydraulic process, which consists in the use of large quantities of water discharged upon the material to be washed, under a pressure sufficient to tear it down and cause its complete disintegration. The hydraulic grounds on this estate lie adjacent to, and on either side of Coffee Creek, along the west side of the main Trinity below its junction with Coffee Creek, and on either bank of the East Fork of the Trinity, reaching from its mouth several miles up that stream. From some limited workings and numerous prospecting tests made of this gravel, it is safe to conclude that the great body of it will pay at the average rate of 15 cents per cubic yard, being fully 20 per cent. more than is obtained in the hydraulic mines generally operated throughout California. Many hydraulic mines have been extensively and profitably worked in this State where the yield did not exceed five cents per cubic yard. The quantity of this material resting within the limits of the com-

pany's claims has by competent experts been variously estimated as amounting to between six and eight hundred million cubic yards. That there are seven hundred millions seems probable enough.

As these deposits are everywhere free from overlying volcanic and other barren matter, and contain very little pipe clay or indurated cement, they can be worked cheaply and effectually, hardly any powder blasting ever being required here. As is the case wherever a heavy wash has occurred, many large bowlders are met with in working these claims, some being so unwieldy that they can only be readily handled with derricks.

CANYON OR CREEK-BED CLAIMS

Consist of the beds of such creeks and gulches as, being known to contain gold, have been secured with a view to obtaining this gold by means of drifting under their beds or by recourse to ground or box sluicing. The company have three of these claims, one covering seven miles of the bed of Coffee Creek, a large westerly confluent of Trinity River, and the other two covering $9\frac{1}{2}$ miles of the bed of the East Fork. The gravel in the channel of these streams has been extensively worked and proved to abound with coarse gold. The great trouble in working them has, however, been to get rid of the water, of which, even in the dry season, they carry a heavy flow. When this company's projected ditches are completed they will divert most of the water from these streams early in the summer, rendering the working out of their beds a comparatively easy matter. That they will pay enormously when drained by this method admits of no doubt, the results reached by parties operating on the creek further up and also by some drifting done on the company's ground establishing this conclusively.

THE WATER RIGHTS AND PRIVILEGES BELONGING TO THIS
COMPANY

Comprise the following, to-wit: A first right to 20,000 inches of the flow of Coffee Creek, a first right to 10,000 of the flow of the main Trinity River, a first right to 5,000 inches of the North Fork of Coffee Creek, and a like right to an equal amount of water flowing in the East Fork of Trinity River; a first right to the entire flow of Eagle Creek and a second right to a portion of Squirrel Creek, together with all streams tributary to their several projected and partially completed ditches; the entire quantity of water secured by these various franchises being computed at 60,000 miner's inches.

DITCHES PROJECTED AND CONSTRUCTED.

For utilizing this water an extensive system of ditches has been planned by the company. The lines of these ditches have all been surveyed and located; much of the grading has been done and some portions of the ditches have been completed. The principal ditch in this series, which takes water from Coffee Creek and supplies it to the tier of mines on the southerly side of that stream, and also to those lower down on the Trinity, is 18 miles long and has a carrying capacity of 10,000 inches of water, which quantity is now flowing through the completed portion of it, consisting of a short section at the upper end. The dam at its head, a very substantial structure, has also been completed. For a distance of ten miles three-fourths of the work has been done on this ditch, and more or less elsewhere along it, a large amount of money having already been expended upon it.

The North-Side Ditch, so called, starting from the North Fork of Coffee Creek, whence it takes its water, extends thence easterly eleven miles to the group of mines situated on the northerly side of Coffee Creek, which it is intended to supply with water. A third ditch has been projected to take water from the main Trinity and deliver it on the mines located along and near that stream. It is intended to be of

large capacity, carrying ultimately ten thousand inches of water. Another ditch will take water from the East Fork and convey it on the company's mines at Centennial Hill, a distance of fourteen miles. Two miles of this ditch have been completed, and a dam built at its head. A small ditch, built by other parties for bringing water on the mines along Squirrel Creek, has been bought by the company, who will find it serviceable for working their ground in that vicinity.

If this company, when their ditches are completed, care to sell water, a good market would offer for all they might choose to spare, there being, apart from their own, much gold-bearing ground in this part of Trinity County that could be profitably worked were water supplied to it. The country all the way from Coffee Creek to Weaverville, a distance of nearly forty miles, abounds with auriferous deposits that would pay to work, if only water could be had for the purpose at anything like reasonable rates. As this entire region is well adapted for fruit and grape growing, some of the land being also suitable for raising grain and vegetables, the time will come when water will here be largely required for irrigation, adding still further to the value of this class of franchises, which have been made perpetual and infeasible by Act of Congress.

Besides the dams built and the ditches so surveyed, graded and partially constructed, much other useful work has been done on the premises, such as laying out and grading wagon roads, cutting trails, etc., whereby all parts of the estate have been made easy of access.

RESERVOIR SITES.

Four small lakes, eligibly situated in the mountains westerly from the company's possessions, have been secured by them, to be converted into receptacles for the storage of water, an end that can be easily accomplished by damming up their outlets. Through the water so stored mining ope-

rations could be kept up during the later summer and early fall, when they can be carried on to best advantage.

GOOD NATURAL CONDITIONS.

The hydraulic deposits of this company are favorably situated as regards the pressure under which the water can be used, as well also as regards outlet or dump. The water here can be delivered on the mines under almost any desired pressure, the fall below the washing pits being everywhere ample to insure an effectual riddance of the tailings, which, however great the quantity emptied into the streams, gulches or rivers, can never become the subject of litigation or complaint; and this, for the reason that they can damage no interest, property or calling. Trinity River not being a navigable stream, its shoaling can harm no one, while the little farming land that exists along it is so situated that it can never be injured by the debris from the mines.

COST OF IMPROVEMENTS AND OUTFITS.

To construct ditches having capacity to deliver on the hydraulic ground say 5,000 inches of water, supply apparatus sufficient to employ that amount of water in washing, furnish additional supplies, and make all further needed improvements, reservoirs included, will require an expenditure of \$150,000. The principal ditches, whereby the water is to be diverted from Coffee Creek and the East Fork, having been completed, the cost of equipping and opening up the cañon-claims will not be large, a few thousand dollars sufficing for that purpose.

GROSS PRODUCTION, AND PROBABLE NET PROFITS.

Adopting the mean of the experts' estimates—700,000,000 cubic yards — as representing the quantity of hydraulic gravel owned by the company, and assuming that it will pay at the rate of fifteen cents per cubic yard, a gross product of

\$105,000,000 may be expected to result from working this class of the company's deposits, sixty per cent of which sum may be accounted net profits. Touching the annual income that ought to be reached here after the mines are in working order, the following calculation will not be much out of the way: 5,000 inches of water will run off daily 8,000 cubic yards of gravel, which, supposing it to yield fifteen cents per cubic yard, will give a daily product of \$1,200. If the mines should be operated only two hundred days in the year, there will result an annual gross product of \$240,000—say, \$130,000 net. If we compute the gross and net revenue to be derived from working the cañon claims at one-half the above figures, we shall be keeping well within bounds, the probabilities being that much larger returns will from this source be realized.

THE GOLD BEARING DEPOSITS, WATER-RIGHTS, DITCHES, AND OTHER IMPROVEMENTS, OF THE DEL NORTE GRAVEL MINING COMPANY.

LOCATION.

The property of this company is situated on Hurdy-Gurdy Creek, at a point about 30 miles easterly from Crescent City, Del Norte County, State of California. This creek is a branch of Smith River, a large stream having its sources in the Siskiyou Mountains, whence it runs west and debouches into the Pacific Ocean. The locality is reached by a good wagon road from Crescent City, a port accessible by the largest sea-going vessels, and the only harbor on this part of the coast.

EXTENT AND CHARACTER OF THE GOLD BEARING DEPOSITS.

This Company own at the above point a tract covering about 1,000 acres of auriferous gravel, the greater portion of which is capable of being worked by the hydraulic process, being free from eruptive or other superincumbent bar-

ren matter. This gravel varies in depth from 15 to 60 feet, having probably an average depth of 40 feet. A portion of this ground is, however, capped with a volcanic flow, so hard that, if ever worked, it will have to be by the drift method of operating. This tract of land is traversed throughout its entire length by one of those Pliocene channels known as "Dead Rivers," and to the partial destruction of which the river bars and gulches in this section of country were originally indebted for their extraordinary fertility, all the upper confluent of Smith River having been noted for their richness in gold. While this gravel is so free from overlying obstructions, it occurs nowhere in the form of an indurated cement, requiring to be broken up with gunpowder or other explosive; neither are there imbedded in it any of those lenticular masses of pipe clay or strata of sand, of such common occurrence in the hydraulic banks further south, and which, while they yield no gold, can be gotten rid of with only a considerable expenditure of labor and water, whereby profitable operations are often seriously interrupted. By reason of this favorable condition of the gravel, as much as two cubic yards of this material can here be run off with one inch of water, a rate much above the average throughout California. This gravel is of good grade, yielding from 15 to 20 cents to the cubic yard, an unusually large percentage.

DITCH AND OTHER IMPROVEMENTS.

Appurtenant to this Company's property is a ditch 9 miles in length, and having a carrying capacity of about 4,000 inches. This ditch takes the water from Hurdy Gurdy Creek and delivers it at the washing pit under a pressure of 280 feet. Under their franchise the Company is entitled to all the water running in this creek, the flow of which, at certain seasons of the year greatly exceeds the carrying capacity of their ditch. For the purpose of saving a portion of this surplus water, a capacious reservoir has been con-

structed on an eligible site near the head of the ditch. Drawing on the water so stored, the working season can here be prolonged to about nine months every year, this exceeding the average working season elsewhere by three or four months. By increasing the storage capacity of this reservoir, for which there are good facilities, the period of active operations could be still further extended.

This mine has been equipped in splendid style, being furnished with iron pipes, monitors, sluices and all the apparatus and appliances common to a first class hydraulic property. Besides being so very complete, everything here is nearly new and in prime working order, the mine for several years past having been and being now actively operated. At present only two monitors are in use, though another is shortly to be added to this number. The plant to date, ditch included, has cost about \$130,000. But so full and perfect is the outfit that not much expenditure on this account will be required for a long time to come. Houses for the accommodation of workmen have been erected, also barns, stables, etc. Shops have been built and stocked and all needed tools are in full supply. The Company have put up a saw mill which cuts all the lumber required about the mine, their land and the country in the vicinity being covered with a splendid growth of timber.

DUMP AND DEBRIS.

The dump or outlet here is all that could be desired, there being fall enough below the washing pits to prevent any troublesome accumulation of the tailings. The debris question, which has caused so much costly litigation and finally led to the closing down of the hydraulic mines in the more central counties, can never come up here, as Smith river is not a navigable stream, has no towns or agricultural lands along it, and no bays or harbors at its mouth to be filled up or bars to be shoaled.

THE PRODUCTION MADE

By this Company amounts at the present time to about \$60,000 per year, of which amount \$40,000 at least consists of net profits. With another monitor, the gross product could be increased by one-third, the increment of net earnings being in a somewhat greater ratio, as but little addition to the present working force would be required.

THE USEFUL METALS AND MINERALS.

Besides turning out gold and silver to the value of \$17,000,000 per annum, California for many years past has produced on an average 50,000 flasks of quicksilver per year, the total production of this metal made to date amounting to 1,400,000 flasks. Owing to the low prices ruling for quicksilver, the output of our mines has, for the past year or two, fallen a little below the general average. It would, however, require only a slight advance in price to cause a corresponding advance in production, the latter having been curtailed only because the owners found they were depleting their stocks of ore without realizing satisfactory profits. With an advance of 20 per cent., and possibly much less, the production in this State would go up to the highest figure ever made—79,000 flasks turned out in 1877; a rate of production that could and no doubt would be kept up here with a restoration of even moderately high prices. The slight improvement in the price of this metal that occurred during the past year, has not as yet had any noticeable effect upon production in this State, owing to the overstocked condition of the markets abroad. Should a sharp foreign demand spring up with a likelihood of being long sustained, the California mines might be expected to respond in an increased production. Meantime, the prevailing low prices of quicksilver favor the production of the precious metals, so that the decline is not all loss.

Quicksilver and borax are found nowhere in the United States except on the Pacific Coast. Borax occurs in only

two States of the Union—California and Nevada; quicksilver in California only. For the discovery of borax we are indebted to the late Dr. John A. Veatch; for the first manufacture of this salt in large quantity we are indebted to the San Bernardino Borax Company, who, in turn, are indebted to the Searles Brothers for the discovery of their deposits, and to the late Speer Riddell for the careful husbandry and intelligent direction that made the enterprise a financial success. The man who, by mere accident, makes an important discovery, is entitled to no very large meed of praise. But where such discovery is the result of forethought and persistent search, it becomes a highly meritorious act, and, as such, deserves recognition by the public, who become the chief beneficiaries of such discovery in the end. Dr. Veatch, reasoning from certain geological indications, that there ought to be borax in the country, set about hunting for it. After traveling many miles and spending much time in the search, he came upon a slight deposit of the mineral, to him more precious than silver or gold. Although this first find was of no great value in itself, it became important as establishing the presence of the precious salt in the country, and thereby causing prospectors to be on the lookout for heavier deposits. Thus it happened that John W. Searles and his brother Dennis, noted prospectors in their day, while exploring the country east of the Sierra Nevada Mountains, found and took up the extensive borax deposits now owned by this company.

The dangers to which the first explorers of these wild regions were exposed is illustrated by the almost fatal mishap that befel John W. Searles while out on a prospecting expedition some twenty years ago. Leaving camp one day, to hunt for game, while passing through a dense thicket he was pounced upon by a huge grizzly bear, which striking him to the ground, commenced chewing him up at a fearful rate. Being alone and utterly powerless, the prostrate man, while his face and limbs were being crunched into a shapeless mass, had presence of mind and self-control enough to offer

no resistance, but lying perfectly still, the brute supposing him to be dead, went away and left him, it not being the habit of these bears to devour a human being unless in a famishing condition. The wounded man, as soon as he had recovered consciousness, though mutilated almost to death, managed to crawl to his horse, which he had left tied near by, and getting on to the animal rode into camp. Having here undergone such rude surgery as his companions were capable of, he was carried sixty miles to the nearest settlement, where his wounds were properly attended to. Though he finally recovered, Searles bears the evidence of his injuries in the deep scars that indent his face and limbs to this day.

The San Bernardino Borax Company, having erected on their extensive saline, which is located in the slate range in the extreme northwestern part of San Bernardino County, capacious and well appointed reduction works have since turned out there immense quantities of the manufactured article. The amount of merchantable borax produced in California since the discovery of these Slate Range deposits approximates 30,000,000 pounds, of the total value of \$5,000,000. How consumers are benefited by discoveries of this kind, is illustrated by the fact that refined borax, formerly worth 30 cents per pound, is now sold at the wholesale rate of about 8 cents per pound, besides which, the money before spent abroad for the article is now kept in the country, while much employment is given to labor here in its manufacture. The management of this company's affairs in the field has from the first been committed to the Searles Brothers, Dennis remaining at his post up till the time of his death, which occurred only a few years ago. John surviving, still acts as superintendent, being assisted now by Mr. E. M. Skillings, who has also been on the ground from the start.

To Mr. Riddell, who died less than one year ago, deeply lamented by a large circle of acquaintance, more than to any other one man, are we indebted for the prosperous growth of the borax interest on this Coast. Owing to the sharp

foreign competition, the business here had to be skillfully engineered with reference to markets abroad. To do this required careful study and an intelligent understanding of the situation. Mr. Riddell, possessing special qualifications for the discharge of this duty, it was by common consent left to him, and to his wise counsels the industry in California was on more than one occasion saved from being crushed out by strong foreign combinations. For his vigilance and foresight in this connection the country owes him much. Mr. Riddell was in fact a man of extraordinary business capacities, and who but for his untimely death, would have made his mark as a commercial manager and financier. He had spent his whole life in fiscal establishments of the highest order, filling some of the most responsible positions in them. In three of the leading banks of San Francisco, he had for years acted in the capacity of cashier. But with all his aptitudes for business, Mr. Riddell was an exceedingly kind hearted and amiable young man. He was not only respected but trusted and loved by all who knew him. Of the departed who have lived amongst us, few have left so many friends or such an honorable and pleasant record behind.

After the death of Mr. Riddell, his brother, D. C. Riddell, was chosen President of the San Bernardino Borax Company, Mr. Henry Krebs, Jr., holding still the place of bookkeeper and Treasurer, and Mr. J. N. Thorn acting as Secretary.

SUPPORTING UNDERGROUND WORKS.

Our progress in vein mining has been great, especially in that department of it which relates to supporting and preserving the underground workings of the mine, the most difficult part of all, but one in which we were at the start particularly deficient, having, prior to the development of the big ore bodies on the Comstock, had but little experience where the roofs and sides of vast excavations had to be supported by timbering. When it came to opening up these chambers on the Washoe ore belt, this lack of skill on the

part of our miners became strikingly apparent, causing the leading companies operating there the greatest anxiety, and filling them for a time, with apprehensions of total failure.

In the Ophir, the first ground exploited, not much trouble was experienced in supporting the walls till a depth of a hundred feet or more had been reached, the stratum of ore removed having ranged only from five to fifteen or twenty feet in thickness. It having, however, at a depth of 175 feet, widened out to a thickness of sixty-five feet, miners were at a loss what to do, the black sulphureted ore being so soft and crumbly that pillars could not be left to support the roof, as in coal mines. In this extremity they adopted the plan of splicing timbers together to hold up the caving ground; but these breaking and endangering the lives of the miners, the company found themselves in a sad dilemma. Skilled engineers and practical miners were alike consulted, but all to no purpose; not a man could be found willing to undertake the difficult job proposed, or even suggest how it should be done. In this extremity, the late William F. Babcock, one of the Ophir directors, having learned that there was a young mining engineer named Philip Deidesheimer, then in charge of a quartz mine at Georgetown, and who had shown great good judgment in opening up some of the rich drift mines at Forest Hill, was so favorably impressed with what he heard that he engaged him at once to go over to Washoe and deal with the Ophir trouble as he thought best. Arrived on the ground, Deidesheimer was not long in devising a system of supports adapted to the necessities of the case, his experience, in the gravel mines of California suggesting the outline of his plan, which has since come into use the world over. In noticing this invention, Eliot Lord, assistant of Clarence King, Director of the United States Geological Survey, remarks as follows: "The Deidesheimer system consisted in framing timbers together in rectangular, each set being composed of a square base, placed horizonially, formed of four timbers, sills and cross-pieces from four to six feet long, surmounted at the corners

by four posts from six to seven feet high, and capped by a framework similar to the base. The cap-pieces forming the top of any set were at the same time the sills or base of the next set above. These sets could readily be extended to any required height and over any given area, forming a series of horizontal floors, built up from the bottom sets like the successive stories of a house. The spaces between the timbers were filled with waste rock or with wooden braces, forming a solid cube whenever the maximum degree of firmness was desired. By adjustments of these sets, the ore bodies along the line of the lode were extracted with comparative ease and security."

Prior to the introduction of this improved method of timbering, so much had some of the purchasers of "feet" on the Comstock become alarmed, that they parted with interests at a sacrifice, which, had they held on to them, would have secured them a fortune. Recognizing the superior excellence of the Deidesheimer system of timbering, mining engineers have adopted it wherever the ground to be supported is loose or the excavation unusually large. And thus it has been in every department of mining, Californians have, through their energy, enterprise and skill, advanced the business more in one quarter of a century than had been done in ten centuries before.

Deidesheimer, having displayed such signal ability, both as an engineer and practical miner, was afterwards appointed Superintendent of the Ophir mine, and remained on the Comstock through the entire Bonanza era, experiencing all the ups and downs of fortune incident to those exciting times.

Being now on a subject that has so connected Philip Deidesheimer's name with this era of the Comstock administration, it may not be out of place to correct here a certain mistatement which, having been suffered to go so long uncontradicted, has at last passed into current history as a veritable fact. This mistatement consists in the wholly unfounded or at least grossly exaggerated rumor that this gen-

tleman had, on some occasion during the bonanza furor, expressed the opinion that the ore body then being developed in the Consolidated Virginia and California ground, contained no less a sum than \$1,500,000,000. The true version of this affair is the following, which we have on the very best authority. At the time spoken of, Henry George, the Publicist, at the instance of Senator John P. Jones, called on Deidesheimer, then in San Francisco, to ascertain from him what were his opinions in regard to the probable size and value of the great ore body. Deidesheimer, while speaking in a guarded way, is said to have expressed himself to the effect that, judging from the way the ore body seemed to be shaping, it might, should it hold to a certain depth, contain ten or even fifteen hundred million dollars. This was a mere casual remark, made in the course of conversation, that gentleman never having embodied these figures in any written report, nor did he ever express the above opinion in writing. Although Mr. George and Senator Jones reported this conversation just as it occurred, it is easy to see how these mere suggestions as to what, under certain conditions, might be, were made by rumor to take the form of positively expressed opinions. It may be that Deidesheimer himself cares little about this perversion of the truth, but as matter of history, and in justice to others concerned, it seems to call for correction.

MODERN GOLD MINING.

STILL A GOOD BUSINESS IN CALIFORNIA—IMPROVED CONDITIONS.

Many persons are impressed with the idea that all the opportunities for making money in the mines of California passed away with the flush times extending from 1848 to about 1855-6. But this is a mistake. To the right kind of a man, having some little means to begin with, and who intends to devote several years to the business, the chances for making fair wages and something more in these mines are nearly as good now as they ever were. It is generally

supposed that the average earnings of these pioneer miners were very large. But this is another mistake, as the State Mineralogist, in his last Annual Report, has pointed out. What has caused these erroneous impressions in regard to the amount of gold per man taken out in these early times, is this: Of the few big strikes that were made everybody heard; of the moderate wages earned and the many dead failures that occurred nothing was said. And so the big strikes have come to be looked upon as the rule, and these poorer results as the exception; whereas the very reverse was true. Comparing present with former conditions, the advantages were by no means so much in favor of the latter as most people imagine. In the early day the cost of living, tools, travel, everything, was excessive. The food was not only dear, but it was of poor quality, which, joined with the other deprivations that the miner had to endure and the hardships to which he was exposed, caused sickness and consequent loss of time—income cut off and outgo large. Then, our miners being inexperienced at the business, many mistakes were made, some of them costly and even ruinous.

All this is changed now. At present a man can live about as cheaply and as well in the gold mines of California as in any other part of the State. He has to undergo no more hardships there than in farming districts, the country being as healthy as any in the world. The business has been learned so well and so perfected in all its departments that few losses or mistakes need occur where proper care is observed. As a matter of fact, gold mining as now conducted in California, is an eminently safe pursuit. Moreover, it is generally profitable; a good deal more so at the present time than manufacturing, merchandising, or even farming itself. Not only so, but it will continue to be both safe and remunerative—it will even improve in the future. Profitable production will increase year by year for two or three decades to come, and perhaps much longer. In short, it is a good time to engage in the business of gold mining in California, whether the parties so engaging be prospectors, laboring miners, millmen or capitalists.

As regards security to life, person and property, freedom from violence and crime, the mining regions of California compare favorably with any part of the country, east or west.

Of the gains made in the matter of machinery, processes, etc., enough has been said in the preceding chapters of this book. But there remain yet two or three things to be noticed in this connection, which, though of secondary importance, should not be overlooked because of the sustenance and encouragement they afford legitimate mining. There are, for example, the extremely liberal laws favoring this industry, prospectors and miners being left, within certain limits, to make such local laws and regulations as best suit themselves. The whole public domain has been thrown open to these classes to take and hold what they choose, with the fewest restrictions and under the least onerous requirements possible. Their predecessors in the field have built splendid wagon-roads all through the mountains, the most of these thoroughfares, which originally cost a great deal, being now free to the public.

WHERE THE MINER CAN STILL MAKE WAGES.

Having said so much about these aids to and allies of the prospector and miner, it remains now to point out to the latter the localities in California where there is still some chance of his being able to earn living wages working on his own account. Owing to the exhaustion of the surface placers, the localities where a man of small means will be able to do even this are at the present day comparatively few and of limited extent. To the man who has money to buy, outfit and work claims, the field open for operations is, of course, much more extensive, embracing both deep placer and quartz mining, of which, a little further on, our object in the first place being to point out to the laboring man who has but little money, the few localities left in the State where he may possibly be able to earn living wages at mining.

First, there are the auriferous beach deposits, extending along the sea shore from a point a little above Crescent City north into Oregon. These deposits have been but little worked for the past eight or ten years, the miners having abandoned them when they ceased to pay less than three or four dollars per day. They will still pay from \$1.50 to \$3.00 per day, averaging \$2.00 at least. They are extensive, and can be easily worked, the climate being such that operations can be carried on the year round. They are reached by steamer to Crescent City and thence by such conveyance as can be had to the mines. The sand here is washed in sluices, the great drawback to these mines being a lack of water at many points for this purpose. With an increased demand, more water would be brought in.

Along portions of the Klamath and Salmon rivers, industrious men, having some little means, might find chances for engaging in hydraulic, drift or river-bed mining to advantage, but all in a small way. There are, of course, to those having ample means, equally good opportunities for engaging in large operations there. Throughout Trinity, Shasta and Plumas counties, there is not much for a poor man to do except prospect for quartz, a business for engaging in which, certain districts in Trinity and Shasta counties offer some inducements. There are a great many localities in the mining regions of California where good wages can be made at gulch washing and ground sluicing in the winter, when water is free and plenty, as there are also many where river bed operations can be profitably engaged in during the latter part of the summer, these places being best found by parties going into the mines and looking about.

In the vicinity of Greenwood, El Dorado County, occur what are known as Seam Diggings, consisting of small veins of quartz rich in free gold, and which can be easily broken out and worked in arrastras, wages being very often made crushing it in hand mortars. Taylor's hand crushing machines, described on page 172 of this book, could here be used to great advantage. The tailings that have lodged in

the gulches and cañons afford in many places good opportunities for men of limited means to make wages re-washing this material in sluices and rockers, the most of these gulches affording enough water for the purpose.

Parties who may contemplate engaging in large mining operations, whether placer or quartz, will find in the preceding chapters of this book a good many hints useful for their guidance.

AURIFEROUS DEPOSITS PECULIAR TO CALIFORNIA—THE GOLD BLUFFS AND BEACHES.

Among the more notable gold-bearing deposits of California, and some of which may be said to be peculiar to this State, are the "Dead Rivers" of the Pliocene age, and the Gold Beaches and the Gold Bluffs found along our northern sea coast. The Dead Rivers and the auriferous beaches having already been described in this book, it remains now to describe the principal Gold Bluff, located in the northern part of Humboldt county, about which nothing has yet been said.

This extraordinary formation consists of a broad ridge or plateau abutting with a bluff face on the ocean, which it overlooks from the east. This ridge, elevated some 300 feet above sea level, is composed mainly of sand, gravel and shingle, deposited by some great river that formerly coming in from the east entered the sea at this point; this ancient river having consisted of the Trinity or Klamath, or more likely of both of these rivers conjoined. When this deposit was formed the shore line here being more elevated than at present, this ridge extended no doubt much further west. With the subsidence of the land the surf has swept the westerly portion of it away, leaving it as at present, presenting a steep face to the ocean. Mixed with the beach sand under this bluff and extending out into the water is much fine gold, the method of gathering which has heretofore been as follows: After a high wind from a certain direction,

creating a cross current, and also after the subsidence of a heavy surf, there is generally left a streak of sand rich in gold. Awaiting the favorable moment when the tide is low a pack train is rushed down and loaded with this rich stuff which is carried up and left on the beach above the reach of high water, where it is afterwards washed in sluices. Although this rich streak is sure to be swept away on the occurrence of the next storm, and may even disappear with the incoming tide, its stay being at best brief and uncertain, still the two companies who own the entire bluff and who have been operating here for many years past, have found the business of gathering and washing this sand exceedingly profitable, so profitable that they have not yet had recourse to washing the bluff itself by the hydraulic process, as could have been done with a comparatively small additional outlay. Latterly, however, these companies, it is said, have concluded to so deal with this material, canals for bringing in water and other improvements looking to that end having been projected. This is what should, and, in fact, would have been done long ago had not the net earnings realized from the simple and inexpensive operations before carried on been so considerable. With the world suffering from gold dearth and so many of our hydraulic mines enjoined from running deposits like these that could so easily be made available for large and profitable bullion production, ought to be at once turned to practical account; the more so, that the conditions here are all especially favorable. Were this great gravel bank once supplied with water and equipped with plant, washing could go on there without interruption the year round and be continued for a period so long that the present generation need not concern themselves about its duration, nor would there exist any danger of their ever being interfered with by legal proceedings. The public will be glad to know that the owners of Gold Bluff have determined to work that deposit by the hydraulic process, if such is really the fact.

TAILINGS DEPOSITS—THE SLATE CREEK BASIN.

This Basin, which is situated in the western part of Sierra county, consists of the depression occupied by Slate creek and its tributaries, which for nearly thirty-five years has been a receptacle for the tailings from the rich gulch, drift and hydraulic diggings that surround it on every side. This is by far the most extensive deposit of tailings in the State, easily available for rehandling, a feature due to the fact that the bed of the creek has such considerable grade as would facilitate the removal of its contents, there being fall enough below, once they are started, to carry them down clean out of the way. To allow of their escape only the rocky barrier at the lower end of the deposit would have to be removed, this being the principal labor here required to be done.

The stream of water running over these tailings has, by concentrating, had a constant tendency to enrich them, there being little doubt but they carry the largest percentage of gold of any similar deposit in the State. Such at least is the opinion of numerous mining engineers and experts who have examined them. Charles W. Hendel, for many years U. S. Deputy Mineral Surveyor, and County Surveyor of Sierra county, reports this Slate Creek deposit to contain many million dollars in free gold, ninety per cent. of which could be recovered by passing the material through sluices; a work that could be accomplished with a comparatively small outlay. An enterprise directed to the opening up of this Basin and rewashing its contents is one that strongly invites the attention of capitalists.

NEW AIDS TO MINING—THE ELECTRIC LIGHT.

In this age of wonders nothing seems more wonderful than the Electric Light, unless, to be sure, it be its popularity and the consequent rapidity with which it has come into use. It seems but yesterday we first heard of this marvellous light, and already in cities, factories, mills,

mines, almost everywhere, we find it is being substituted for gas, oil, and other illuminators, because of its greater convenience, cheapness, safety and efficiency—in short, its superiority in every property required of an artificial light.

Into many of the mines, mills and reduction works further east, this improved light has been introduced, affording invariably the greatest satisfaction. Keith's Dynamo system seems to be the one generally preferred, and as there is now a company in San Francisco supplying it on very moderate terms, it would be well for the mine and mill owners in California to avail themselves of this new light without delay. The gains reached through its employment are important, and it is a little singular that the California miners, who pride themselves on their enterprise, should have shown themselves so remiss in this particular, the electric light having as yet been placed in hardly more than half a dozen mines and mills in the State. Where introduced, however, it has served such an excellent purpose, that a return to the old style of lamp has not been thought of. The use of the electric light by reason of its greater safety, will sensibly reduce the cost of insurance on quartz mills and other reduction works. The office of the above company is at Room 40, Nevada Block, San Francisco, where miners should apply or send for circulars giving all needed information.

THE ELEVATED WIRE-ROPE-WAY.

We have in the preceding pages made frequent mention of the elevated wire-rope or tramway, testifying to its effectiveness for the transportation of ores from mines to mill, as demonstrated in numerous instances where this device is being employed for such purpose in California. So well does the machine seem to do its work that it is becoming very popular. While this tramway can be used to advantage in any locality, there are certain situations to which it is especially adapted; where the snow falls deep in winter,

where there are narrow gorges to be crossed, or the surface to be traversed is full of inequalities, precipitous and rocky, it is the only method of ore transportation that should be thought of. Besides having been put up at several places in California, these tramways are to be found throughout the mining regions of the entire Pacific coast, Mexico included. All through the Rocky Mountain districts they are to be met with, the rougher the country the greater the demand for them. There are in fact, localities where they have to be adopted, less as a matter of economy than necessity. Regions fissured with abrupt chasms and gashed with narrow canyons, can be rapidly spanned by one of these endless iron ropes, where the construction of a pack-trail would be difficult, and a wagon road impracticable. Some of those put up in Mexico have a clear span of 1,600 feet, and yet perform their work efficiently. But apart from these extreme cases, the employment of the machine is everywhere attended with both convenience and economy. Engineer Philip Deidesheimer, the mining engineer, an authority in such matters, having put up one of these endless traveling wire ropes on the Young America mine, at Sierra Butte, is so well pleased with its operations that he will include one in the extensive plant he intends to place on the Phenix mine, now being opened in the same neighborhood.

This endless ropeway is the invention of A. S. Hallidie, forming a part of an extended system of implements and mechanism of a similar kind, such a hoisting cables, street railroad cables, &c. And what Mr. Hallidie's fertile brain has devised, his busy hands has worked out in practice, the immense wire manufacturing establishment at North Beach, San Francisco, being the creation of his industry and genius. Founded in 1852, it has grown gradually to its present large proportions and great perfection, standing to-day, not only the oldest but among the largest and most important industrial enterprises on the Pacific coast, 250 men finding steady employment here. A vast amount of products in this line are turned out annually, the manufacture of wire ropes and

cables being a specialty. We believe, in fact, that this is the only place in the United States where the flat wire cable is made. Besides supplying the entire coast, the products of the California Wire Works go as far east as Denver, and possibly still further in that direction. A visit to the great industrial hive at North Beach could not fail to interest a person fond of mechanical pursuits or possessed of an inquiring turn of mind; there being also a great deal worth seeing and studying at the business office and depot of the company, 327 Market street, San Francisco, where a great variety of articles, both useful and ornamental, are open to inspection.

WHAT THE IMPROVED SAWS DO FOR MINING.

So intimately connected with mining is the cutting of lumber, that we introduce here a paragraph concerning some of the implements lately perfected for facilitating operations in that line of business. We allude, of course, to the improved style of saws now in use in the sawmills and logging camps throughout the lumber regions west of the Rocky Mountains, nearly all of which come from the establishment of N. W. Spaulding and the Pacific Saw Manufacturing Company, Nos. 17 and 19 Fremont street, San Francisco, who enjoy the reputation of making a saw of superlative excellence. These works are among the earliest established on the Pacific Coast, having been started in this city at a time when the attempt to manufacture here anything from steel, especially edged tools requiring skillful and careful tempering, was looked upon as premature and almost chimerical. Many of us remember the little shop, with the smithy attached, of N. W. Spaulding, when it was struggling for an existence among our pioneer industries, and how perseverance and merit won in the end, despite a limited market and severe outside competition. Out of these small beginnings has grown the present large and diversified business carried on at the above establishment, where every implement pertain-

ing to this branch of manufacture is made, and its excellence guaranteed in every particular. It is, in fact, the policy of these people to see that nothing leaves their hands until it has been made as perfect as possible. Hence the general satisfaction insured their patrons, who may be said to consist of the makers of lumber and the workers in wood throughout the entire Pacific Slope of the continent. It is said that Mr. Spaulding, a natural inventor and mechanic, determined, years ago, that he would turn out the best saw that it was possible for human skill to produce, and it is generally believed that he has succeeded in doing so. Lately, however, he has added another and very valuable improvement to his already very complete saw, by the introduction of what is termed the chisel-bit, the advantages of which are conceded by all who have used it to be very great. It does in fact almost double the life of the saw. With the introduction of these more efficient tools, the cost of lumber has been steadily reduced, until it is furnished to consumers, miners included, at rates so astonishingly low that it is hard to see where there is left any margin for profit, though, of course, there always must be some.

METALLURGICAL WORKS—THE SELBY SMELTING AND LEAD COMPANY.

With improved transportation facilities mining operations are likely to be much extended in the regions east of the Sierra Nevada, as well as in many other of the outlying base metal ranges, increasing the necessity for having on this Coast works of large capacity for treating every class of smelting and refractory ores, and also for parting and refining the precious metals. A good deal of the gold bullion of California contains a notable percentage of silver, which, as a general thing, is now lost to the miner and millman for want of parting, its presence merely reducing the fineness of the gold. The seller, in order to realize the value of his silver, should take his bullion to a suitable metallurgical establishment and have the two metals separated.

While the Selby Smelting and Lead Company have supplied to our miners and millmen for more than twenty years an establishment of this kind, it is to be observed that these works, formerly located at North Beach, in the city of San Francisco, have lately been removed to the Vallejo junction, on the line of the Central Pacific and the Southern Pacific railroads, twenty-five miles from the city, where, having been greatly enlarged and improved, they are now in full operation. The new site is in all respects a most eligible one, being at or near the junction of several different railroads, and at a point where rail and deep water meet, the largest sea-going vessels being able to lie at the Company's wharf. Here ocean steamers and up-river craft coming together find at all times ample accommodation and security in the roughest weather. Here can be seen cars loaded with ores from Idaho, Utah, and Nevada, and other points in the distant interior, and vessels with similar freights from Alaska, Arizona, and the West Coast of Mexico.

These works, so easy of approach from every direction, are very extensive and as complete in all their appointments as skill, science and money could make them. Here all the best methods, mechanisms and processes known to modern metallurgy have been introduced and are being manipulated by experienced and skillful hands. The place is, in fact, an exponent of all that is most advanced in this line of business, the perfection here attained inuring, of course, to the benefit of its patrons. The extent of the business done at these works in the past is indicated by the fact that there have been turned out here over 2,000 tons of refined silver, 200 tons of gold, and more than 70,000 tons of lead.

It is not our purpose to describe here this great establishment in detail, the mining community being more interested to know something in regard to its means of approach, character for reliability, etc. As already remarked, the locality can be reached by water and rail from every section of the country. The entire railroad system of the Coast and all the large navigable rivers of California, together with the

ocean routes, converge at or near this point. Touching the high character of these works the mining community on this Coast scarcely need any assurance, the institution from the time it was founded by the late Thomas H. Selby, in 1863, having been distinguished for reliability and fair dealing. This is the reputation it has enjoyed during all these twenty-two years. The founder of these works, who was a man of exalted character, seems to have impressed his traits indelibly on the management, continued under his son Prentiss Selby, who from boyhood was trained to the business.

The officers of the Selby Smelting and Lead Company are Andrew J. Ralston, President; H. B. Underhill, Jr., Secretary, and Prentiss Selby, Superintendent. Office of the company, 416 Montgomery street, San Francisco, where parties having bullion to refine or ores to sell should apply.

THE MINES, THE MINERS AND THE RAILROADS.

While the various gains and improvements mentioned have contributed much towards placing the business of mining on a more healthy and steadfast basis, no one thing has done so much toward extending this industry into new and distant fields as the construction of railroads, which, rendering transportation and travel cheap and expeditions, have thereby caused its rapid expansion, carrying it into regions where it otherwise would not have reached for a great many years. And there is reason to hope that these means for facilitating the spread of mining will be further increased, unless to be sure the purposes of the railroad builders shall be defeated by communistic threats and insane legislation, a policy which, writing in the interests of the miners of this Coast, we undertake to say, they do not approve of, and with which they are not in sympathy.

Appreciating the advantages to themselves and the entire community that have resulted from the extension of railways into remote, desert and mountainous districts, they are op-

posed to the warfare that has so long been waged against the railroad companies, and knowing the same to be without reason or warrant, deprecate its longer continuance. Generally speaking, the miners on this Coast are a well informed, fair-minded class of men, altogether too intelligent and independent to allow themselves to be used for the furtherance of any rank injustice, and they who count on their co-operation to such end, will meet with disappointment.

The men who in times past, riding on mule back or in mud-wagons, have wallowed through snows on the mountains, and through deep sands on the deserts, consuming weeks, spending much money and suffering every inconvenience making a journey that can now be made in a few hours, at small expense and with the greatest comfort, pay little heed to what demagogues and idlers have to say about railroad monopolies and overcharges; nor does the merchant who, in former days had to pay excessive freights on wagon transportation, his goods delayed and often badly damaged through dumpage in the mud, exposure to rains and much re-handling, greatly concern himself about the vaporings of the malcontents and aspirants to official place, their following mostly the patrons of the whisky shops and tools of politicians, who care little about the welfare of the working man, the miner or the community at large, so they be able themselves to live high, dress well and shirk the performance of honest labor. It is time these aggressive movements and menaces, whether directed against corporate or individual property, should cease, their toleration for so long a time having through their effect to discourage enterprise and intimidate capital, already worked incalculable mischief. But for these assaults on vested rights, coupled with threats of communistic legislation, the railroad system of the State would before this have been greatly extended, the iron rail reaching into, populating and opening up mineral territory that now remains almost without people and but little explored.

What the presence of railroads accomplishes for remote and sterile districts is shown in the case of the Trans-Sierra region, stretching from Mono Lake south four hundred miles across the most arid and desolate section of the State. Attempts were made more than twenty years ago to inaugurate mining enterprises in that then isolated and almost inaccessible desert, but despite much money expended and the most strenuous efforts made to that end, the whole resulted in failure, the country having, after a few years, been abandoned and suffered to relapse into its primitive condition, from which it has been successfully reclaimed only since the advent of these roads, the Southern Pacific striking diagonally across the southeastern, while the Carson and Colorado traverses the northern portion of the Sahara. With the coming of the railroads miners have returned to that region, work on the abandoned claims has been resumed, new discoveries have been made, and prosperous mining camps have sprung up there, the Calico district having already become a large and profitable producer of silver bullion, thus making California a large silver as well as a gold producing State. Even further south, in the still more remote and inhospitable Colorado wilderness, mines formerly abandoned are now being worked with success. Having been rendered accessible through the arrival of the great modern civilizer, mines will soon be opened, mills will be built, and prosperous communities planted all over this region, which otherwise would for many a year have remained a solitude and an industrial waste.

While the Southern Pacific has thus made it possible for these dry bones to live, impressing values on a region before so utterly worthless, H. M. Yerington, by pushing his narrow-gauge track far out over the sage barrens, connecting the Inyo, Mono and the Esmeralda counties with the Central Pacific, has made himself the benefactor of two States.

Looking nearer home, we see how our local railroads have in like manner increased population, stimulated improvements and added largely to the material wealth of the sev-

eral districts traversed by them, these roads seeming to impart something of their own energy to every interest and pursuit brought within their reach. If quartz mining in and about Nevada City has been notably advanced, such advancement is largely due to the narrow-gauge railroad connecting that place with Colfax, on the Central Pacific. Though covering a distance of only twenty-two miles, this road, under a careful and economical but at the same time just and liberal management, has, by reducing the prices of freight and contributing to the general convenience, had the effect to keep every branch of business throughout the central part of the county in a prosperous condition, and this notwithstanding the entire suspension of hydraulic operations.

Whatever others may say or think, the desire of the miners is for more railroads. We had almost said they care little about the alleged extortions practiced upon them, so they get the roads. Certain it is, they will not complain if the railroad companies shall, as heretofore, charge for their services only fair and reasonable prices. The miners are friendly to the railroads, and we think this feeling is reciprocated.

ANOTHER CHERISHED INSTITUTION

With the hardy miners, especially those whose enterprise is apt to carry them into new and little explored regions, is Wells, Fargo & Co.'s Express, it being the habit of this company to establish an office in every newly populated district as soon as business will justify. No matter how far the prospector may get away, he feels that he has not cast loose from all civilization so long as he has this sure and ever ready means of communicating with friends and home. Not only so, but he can, through this same channel, receive and remit money, and have sent to him packages, merchandise, machinery, etc., everything being conveyed with the greatest dispatch and at reasonable enough prices. This is one of the old-time institutions of the Pacific Coast, and which, having served the miners faithfully for so many years,

they could not well dispense with; nor would they even like to see its usefulness crippled or curtailed by official intermeddling. This Express performs a service which the United States mails could not do, and is pretty sure to be on the mining frontier in advance of "Uncle Sam."

The familiar sign wherever seen, signifies enlightenment, growth and progress. Its presence in pioneer towns is accepted as the harbinger of population, business and improvement. The managers of this concern are shrewd, far-seeing men, not apt to establish a branch in any place till they are pretty well assured of its future. Hence its significance to the inhabitants of new mining camps and border settlements. In the wild interior, where civilization is struggling to get a first foothold; in the outer mountains, where the hardy miner pursues his vocation and the prospector roams, this simple name is hailed with delight, cheering these sojourners, far out in the wilderness almost as much as if a fort had been planted there.

NEED FOR A LITTLE OF THE OLD-TIME ENTHUSIASM.

Writing several months ago it was stated in the earlier chapters of this book that more attention ought to be paid to gold mining in California as a means of absorbing some of the unemployed labor that had then already accumulated on our hands. Owing to the depressed condition of every other branch of business, the number of idle men in the State has since been largely increased, imparting to the argument in favor of a more active working of our gold mines additional force. There is said to be at this time as many as eight or ten thousand unemployed, or but partially employed men, in and about the city of San Francisco; a condition of things, seeing we are on the verge of winter, with no prospect of any improvement taking place in our other industries, calculated to arrest public attention, and for which our business men, capitalists, and property own-

ers will naturally be seeking some remedy. Now, this entire army of idle men and a great many more could find profitable employment in our gold fields were a little aid and the proper encouragement extended to them, and thus, to the great advantage of all, be converted from mere consumers into active producers.

Not since the death of William C. Ralston have more than a few of our men of large wealth greatly distinguished themselves by their individual efforts to found or foster new industries, or otherwise provide employment for those who need it, the course pursued by Ralston being in this respect one which even the highest in the land might justly aspire to emulate. If any there be among our rich men having an ambition to live in the future they could do no better than imitate the example of the great banker in this particular; for of all our notables the name of none will abide so long in the memory of the many as will his. * James King of William, the Reformer, the sturdy Broderick, the persuasive and patriotic Baker, the inspired Star King, and James Lick, the philanthropist, have, each among different classes of society, their friends and admirers; but Ralston's adherents include every class and condition in life—the high and the low, the rich and the poor alike, he being by the needy and work-famished masses especially missed and lamented.

It was wonderful the hold the man had on these more lowly classes of people. You cannot go so far up into the mountains, nor so far out on the deserts, but you meet with rough clad, rough handed men who continue to speak of him with a strange warmth of feeling. The censorious may cavil, and the exacting find fault, but the great middle class and the multitudinous poor, go on the same, thinking of him as a public benefactor. It is useless to criticise a man like that! Of what avail your logic when listeners await only an opportunity to interpose with an "Ah, yes! to be sure; but then you see, after all," and going on in their own way, extenuating this and excusing that, end by eulogizing everything the man ever said or did!

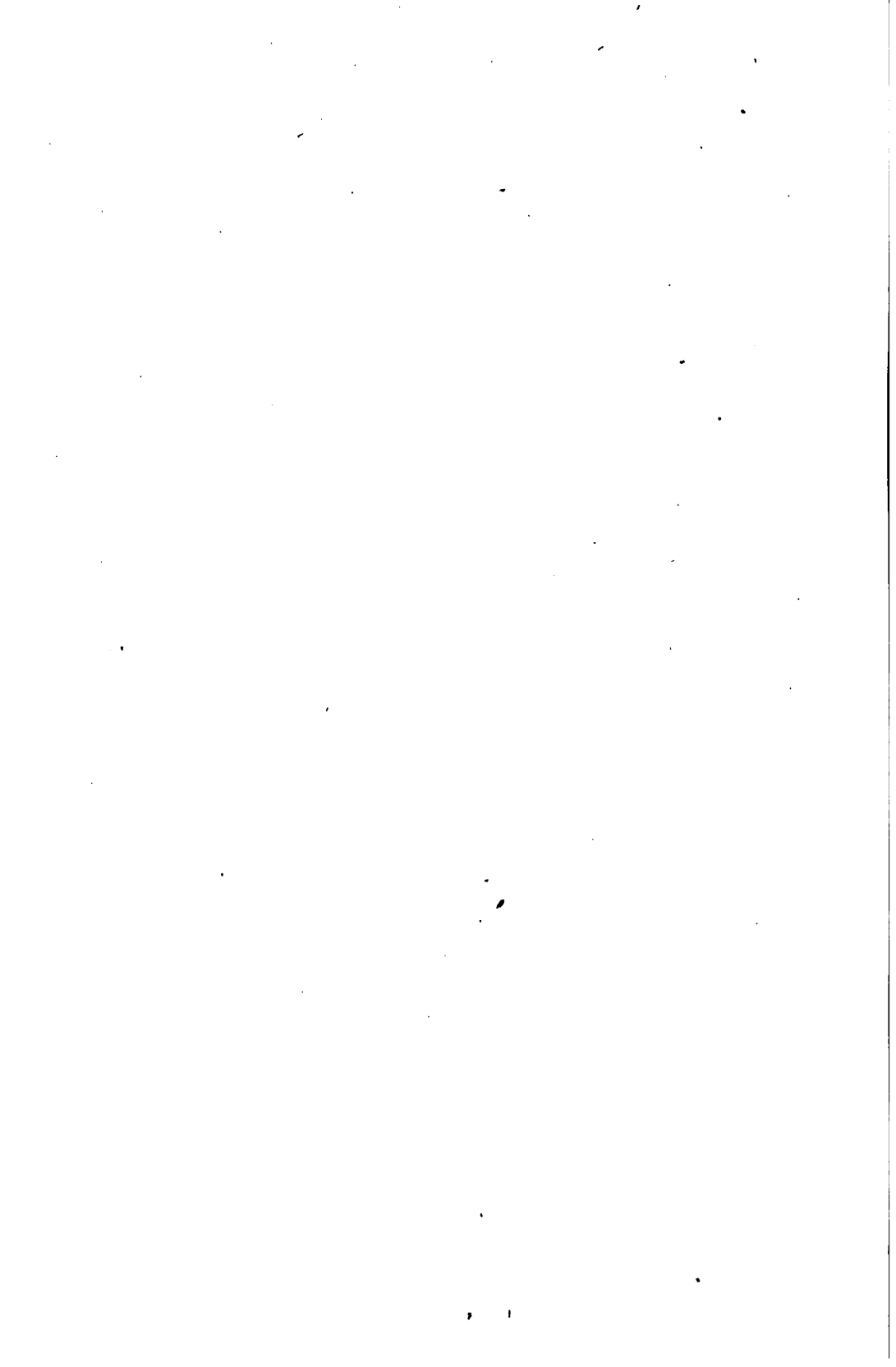
It may be that our banker's business methods were in some respects a departure from those that obtain in older and more staid communities. But they were in harmony with those that here largely prevailed. If he were sanguine and adventurous, so were we all. If he were inclined to sometimes discount the future, which of us was not? He was in fact our Great Commoner, the most thoroughly representative Californian that ever lived. Even in his failings he was typical of the people and the times, and if in some things he was disappointed in his calculations, there was never disclosed in any act of his a selfish motive, or an unworthy purpose. His high aims and generous impulses were bred of the heart, his mistakes of his hopeful nature, and the vicissitudes incident to all human affairs.

In the efforts now being made to bring about a partial restoration of gold mining in California there is required something of the old time liberality and enterprise on the part of our moneyed men, as well as of increased energy and active exertion on the part of the working classes. These aroused and acting in concert there would soon follow a marked improvement both in the business of the country and the condition of those who toil for a living.

IN CONCLUSION.

It may be remarked that the California gold fields, while they still afford many opportunities for the laboring man to earn moderate wages, present to the capitalist and even to men of small means, numerous openings for the advantageous employment of money. Parties now embarking in the business of gold mining in this State have the benefit of all the improvements made, and the experience gained in a period of 37 years—the life-time of the industry in California. How great have been the gains made during this time, may be inferred from the fact that \$30 ore was at the start rejected as worthless, whereas now, \$2 ore can, under the most favorable conditions, be worked with profit, as shown by the operations of the Grand Victory Company at Diamond Springs, Eldorado County, who have been running their mill continuously for five years on ore of that grade, and report satisfactory resultant profits. It is true the ore here is soft and easily pulverized, but at the Josephine Mine, in the same county, ore has for some time been mined and milled at a total cost of only \$1.50 per ton, and the owner of the property, Joseph M. Nougues, the well-known lawyer of San Francisco, expects, it is said, to introduce here such further improvements as will reduce the present cost of mining the ore from one dollar to eighty-five cents per ton. What tends to cheapen milling here and elsewhere along and adjacent to the line of the California Water Company's Ditch, is the reasonable rates at which water for motive power is supplied to the quartz mills, of which there are a number running in that neighborhood, the Hon. Thomas Findley, Superintendent of this Company's extensive system of ditches, having always pursued a liberal policy toward the miners in this respect.

In the drift as well as the quartz mines, the chances for men of moderate means acquiring valuable properties or interests therein, are still good, as is shown by the success of the Derbec Company, which owns now one of the best properties of the kind in the State, though it has been self-sustaining from the first. This Company, who own an extensive section of one of the "Dead Rivers" on the famous North Bloomfield channel, have their ground well opened up and for seven years past have been taking out daily, an average of 140 tons of gravel that pays at the rate of \$2.75 per ton. They work on an average 75 men and pay their miners \$3 per day, and yet their net profits are large. Only perseverance and industry are necessary for men laboring to work out similar results in many parts of our gold fields, and our advice to those out of employment is to repair to the mines, and if they are not already acquainted with the business, work for a time for little or no wages until they acquire some knowledge of it, after which they will be able to earn fair wages, with a good chance of locating or otherwise getting hold of mining properties and interests that will enable them to become their own employers, and in the end insure them a competence, and perhaps a fortune.



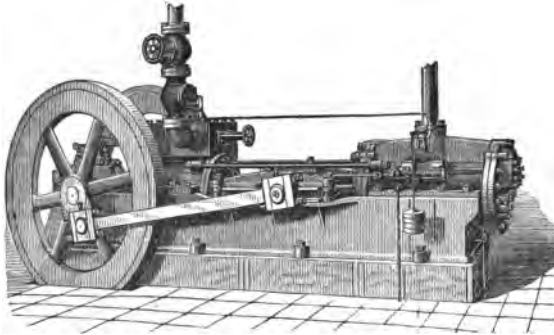
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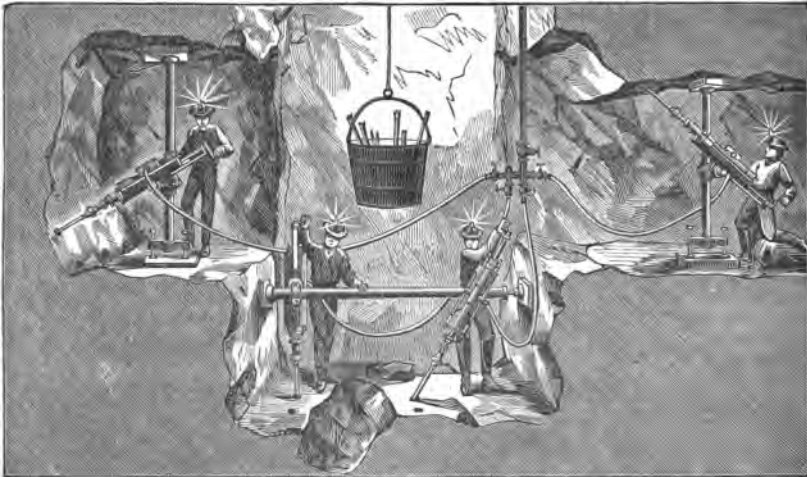
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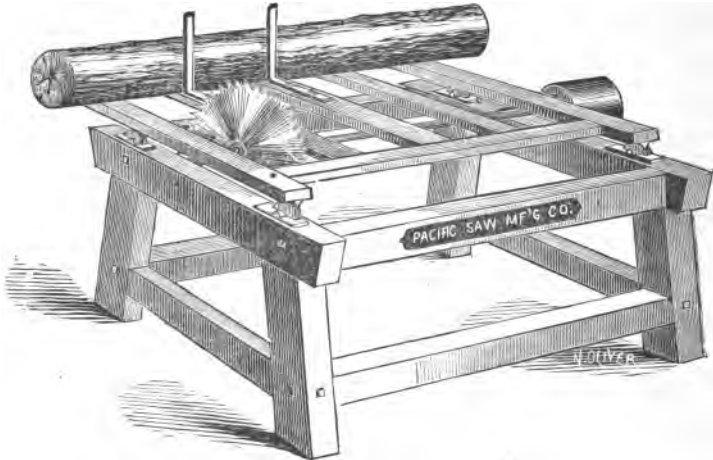
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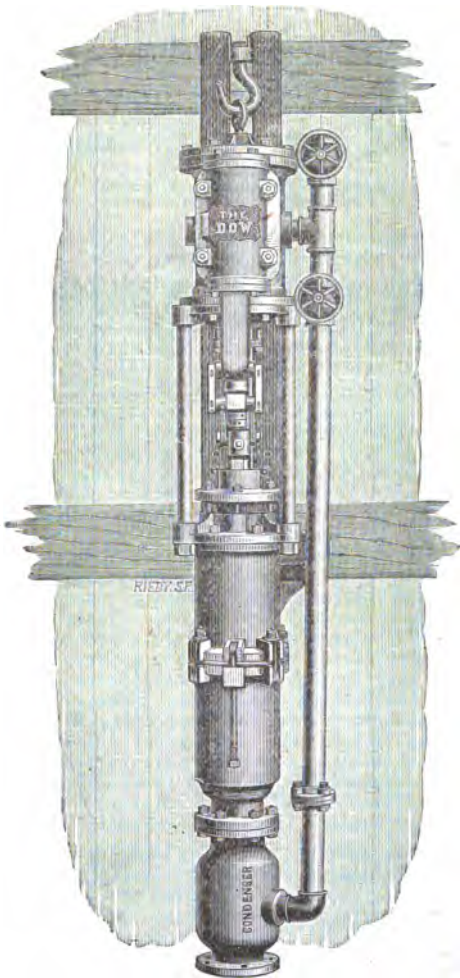
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**Extract from Superintendent's Report Sept. 1st, 1885, to Alaska Mining Co.,
Pike City, Sierra Co., Cal.**

To permanently discharge the very large and increasing flow of water from our mine has been the great subject of consideration, labor and demonstration the past year, for upon this point success depended. To successfully run the mine until its earnings should so equip it was impossible, and plans must be varied or other means tried; so after thorough investigation the Worthington Compound Duplex Mine Pump, 18 $\frac{1}{2}$ " high pressure, 29" diameter low pressure steam Cylinders, and 12" diameter plungers, was selected on account of its long tested merits. The pump was successfully started on June 6th last, pumping from 550 to 600 gallons per minute, which recently increased to over 1,000 gallons per minute, or over 1,400,000 gallons per 24 hours. We venture the assertion that no mine upon this coast with an equal flow of water was not either abandoned or was equipped with an expensive plant of pumping machinery, which with foundation and freight would cost from \$150,000 to \$500,000.

The weight of the Worthington Pump with connections, is 15 tons. Its cost, including freight, fittings, and excavating over 1,200 tons of rock for its room and reservoir, has only been \$12,650. Steam is conveyed through a 5" pipe down 500 feet from the boilers; the steam pipe is wrapped with hair felting encased in canvas, and the loss of steam by condensation is insignificant, steam gauge at pump registering same as at boilers. We pump into a drain tunnel 400 feet above the pump. It has effected a saving of \$35 per day pumping alone, and of the Worthington Mine Pumping Engine, after three months' severest test, as compared with other forms of steam pumps or Cornish plant we have tested, we are prepared to say, that for the service it renders, the durability its mechanism insures, the economy of its use, and the comparatively small cost of its plant, the Worthington stands unrivalled and incomparable. (Signed) E. P. BATES, Superintendent.

The Worthington Compound Condensing Pumping Engines, with our new high duty attachment, is destined to supersede all other pumping engines of whatever type. These improvements consist of a simple attachment that can be placed upon any form of Worthington pumping engine, and that without altering its character of motion in the slightest, enables it to perform its work with the consumption of as little fuel as would be required by any other form of pumping engine. In other words, this attachment enables the Worthington Pumping Engine to readily achieve a duty of 100,000,000. Exhaustive tests have been made where this duty has been considerably exceeded.

As numerous patents are still pending on this improvement, a detailed description of its construction cannot now be published, but a pamphlet fully descriptive of it, is being prepared, which will be shortly ready for distribution.

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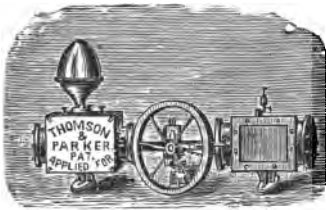
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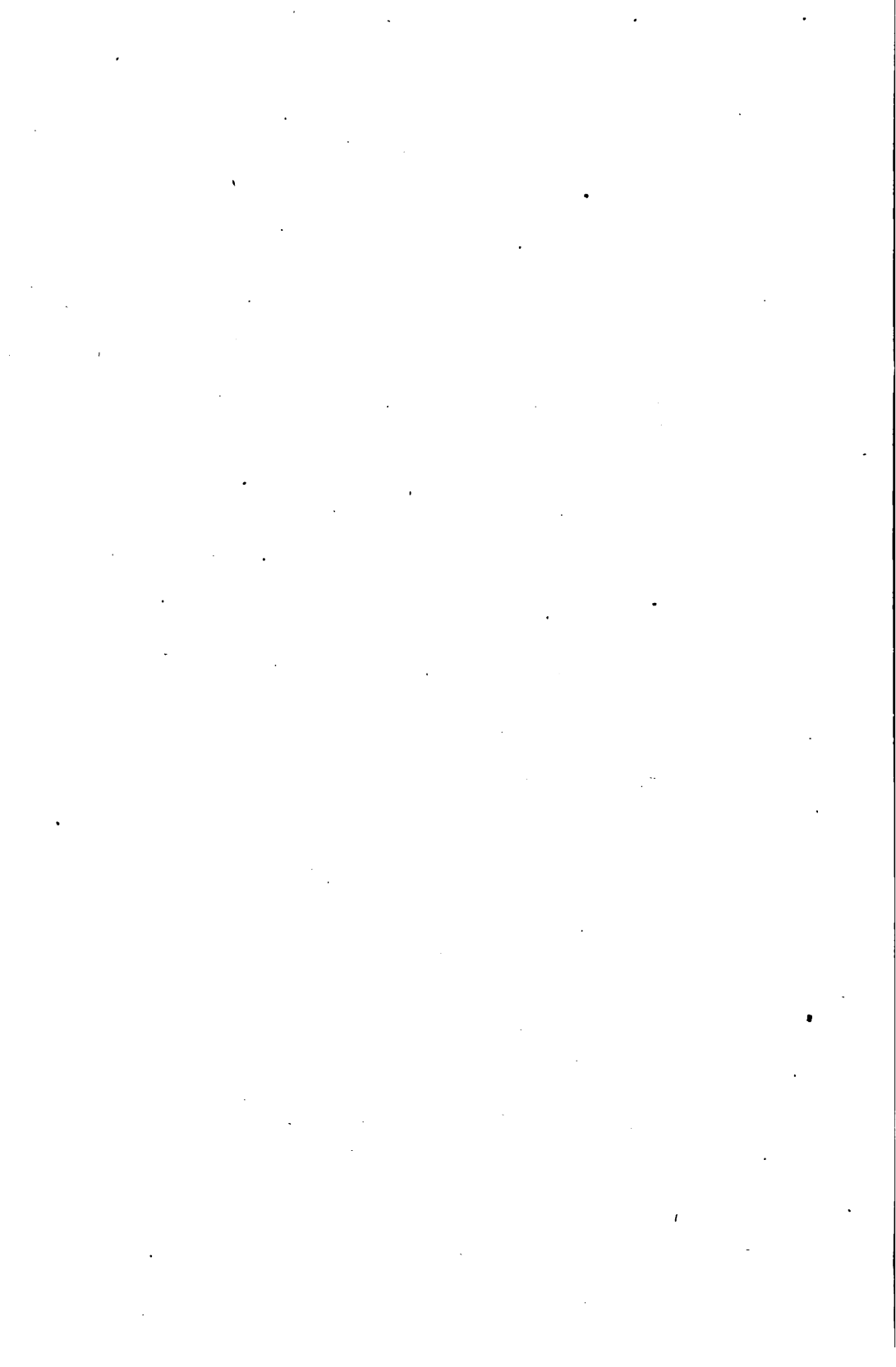
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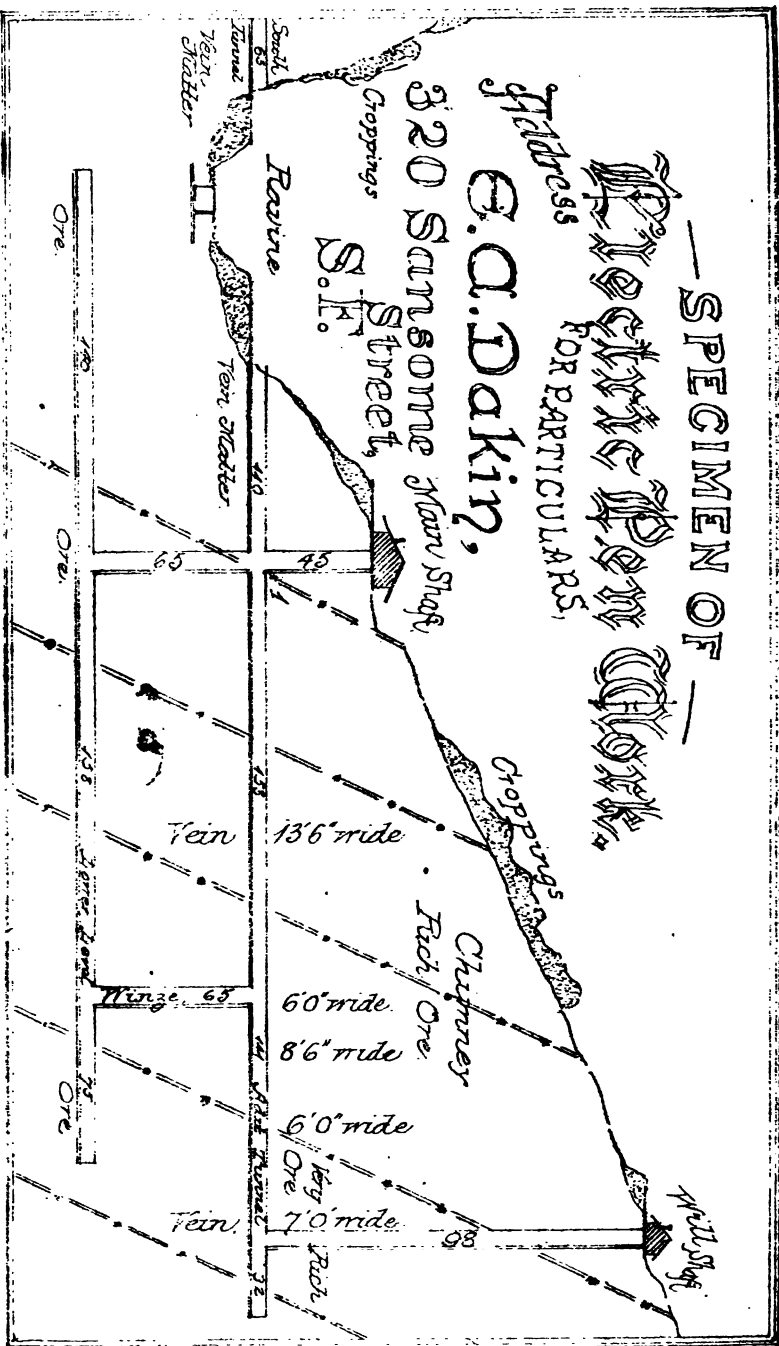
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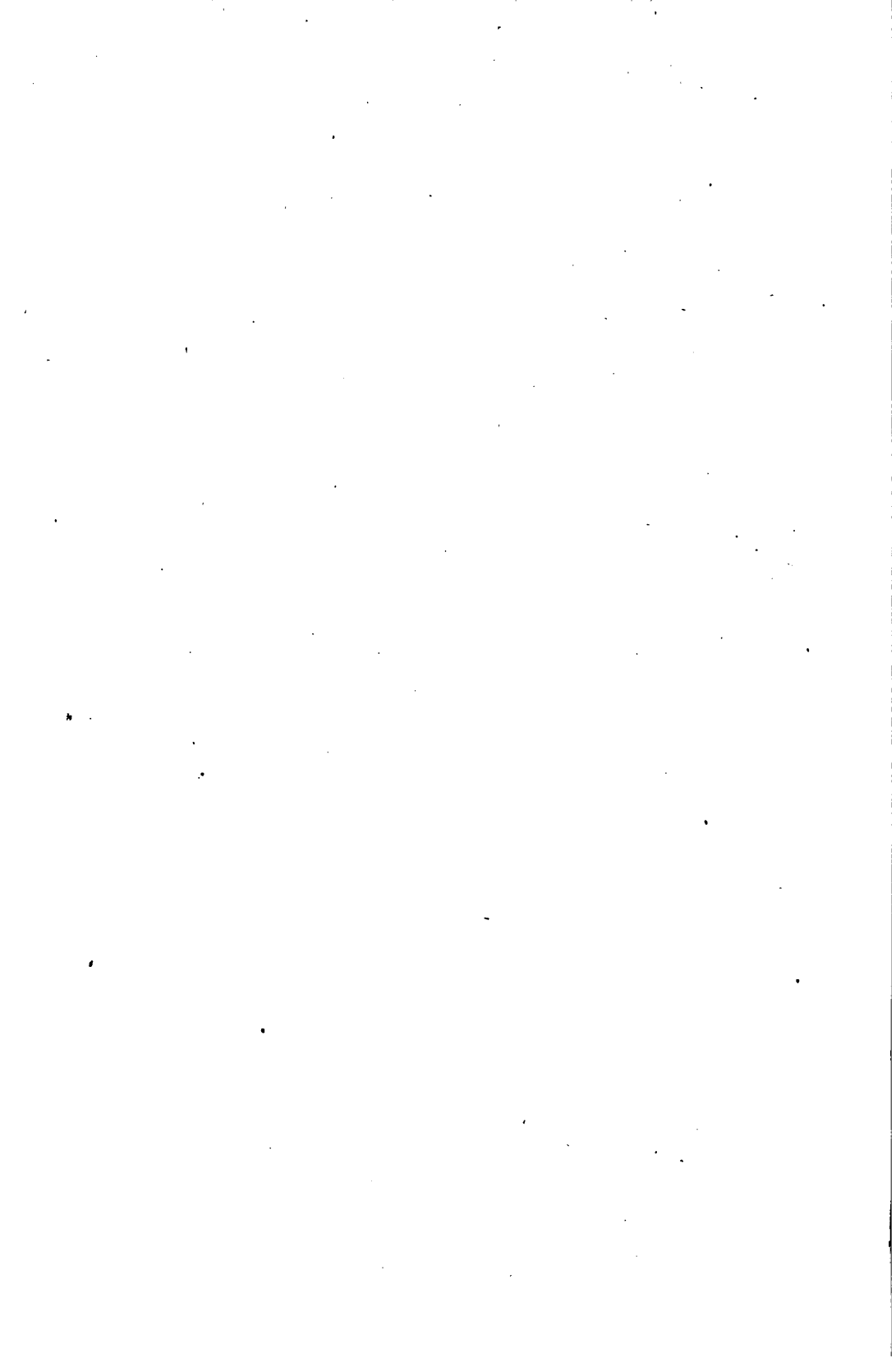
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